



February 18, 2005

**NOTICE OF REQUEST FOR BID
FOR
CARROLL AVENUE PUMP STATION GENERATOR**

The City of Lynchburg is seeking sealed Bids from qualified firms for the Carroll Avenue Pump Station Generator

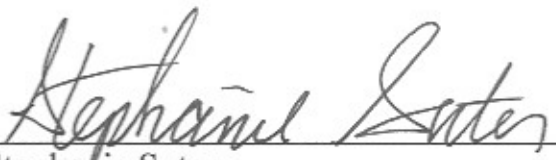
An **Optional** Pre-Bid Conference will be held at 10:00 a.m., March 3, 2005, in the Second Floor Training Room, City Hall, 900 Church Street, Lynchburg, Virginia.

Bids will be accepted until, but not later than Wednesday, 3:00 P.M., March 23, 2005, at the address below:

Procurement Division
Attn: Stephanie Suter
Third Floor City Hall
900 Church Street
Lynchburg, Virginia 24504

Bids received after the above stated time will not be considered.

Questions regarding the solicitation portion of this bid shall be addressed to Stephanie Suter, Buyer, (434) 455-3963 or fax number (434) 845-0711 or email to stephanie.suter@lynchburgva.gov.


Stephanie Suter
Buyer

PROJECT MANUAL
SPECIFICATIONS AND OTHER DOCUMENTS FOR

Carroll Avenue Pump Station Generator

CITY OF LYNCHBURG PROJECT NO. 04036-W



February 2005

FINANCIAL SERVICES
PROCUREMENT DIVISION
THIRD FLOOR CITY HALL
LYNCHBURG, VIRGINIA 24504
TELEPHONE (434) 455-3970
FAX (434) 845-0711

ADVERTISEMENT FOR BIDS

Sealed bids for the Carroll Avenue Pump Station Generator will be received by the City of Lynchburg, Procurement Division, Third Floor, City Hall, Lynchburg, Virginia until 3:00 p.m., Wednesday, March 23, 2005 and then publicly opened and read aloud in the Bidder's Room, Third Floor, City Hall.

Drawings and project manual may be viewed and printed directly from the City's Procurement website: www.lynchburgva.gov/home/index.asp?page=981.

An optional pre-bid conference will be held at 10:00 a.m., March 3, 2005 in the 2nd Floor Training Room, City Hall, 900 Church St., Lynchburg, VA. The purpose of this conference is for Bidders to familiarize themselves with the site and the existing conditions and to ask questions pertaining to the contract documents. A site visit will be available immediately following the pre-bid.

All requests for clarification of or questions regarding this Bid or for additional information must be made in writing, by facsimile (434) 845-0711 or email to stephanie.suter@lynchburgva.gov and received by 2:00 p.m., March 10, 2005.

BID FORM

Stephanie Suter
City of Lynchburg
Procurement Division-Buyer
900 Church Street
Lynchburg, VA 24504

Dear Ms. Suter:

The undersigned, having carefully examined all contract documents for the Carroll Avenue Pump Generator and also having examined the site and local conditions affecting the work, hereby proposes to furnish all labor, equipment, materials, and services, and to perform all operations necessary to execute and complete the work in accordance with the plans and specifications prepared by Master Engineers and Designers, P.C., together with Addenda Numbered _____, issued during bidding period and hereby acknowledged, subject to the terms and conditions of the Agreement for the amount of:

TOTAL BASE BID:

_____Dollars
(\$_____).

This contract is to be awarded on the basis of the summation of the several unit price and lump sum items and using the estimated quantities. The above shall be referred to hereinafter as the Base Bid. It is understood and agreed that the Owner, in protecting its best interest, reserves the right to reject any or all bids or waive any defects in favor of the City.

Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of bids, and final payment for all Unit Price Bid items will be based on actual quantities, determined as provided in the contract documents. It is understood that the Owner reserves the right to raise, lower, or eliminate any quantity or item.

As authorized representative to bind this Company to a Contract, I affirm that we are properly equipped to execute work of the character and extent of the agreement and so covered by this bid and will enter into agreement for the execution and completion of the work in accordance with the specifications of this bid. We further agree that if awarded the contract, we will commence the work within 14 consecutive calendar days of the mutually agreed date stated in the "Notice to Proceed" and will maintain a work force large enough to execute the work and all obligations within the time specified above. The project shall be completed in its entirety within 150 calendar days following the issue date of the Notice to Proceed.

The unit prices listed herein cover the furnishing of all labor, materials, machinery and equipment, and completing the work in accordance with plans, specifications, and contract provisions herein set forth.

We agree to pay as liquidated damages, the sum of Two Hundred Dollars (\$200.00) for each consecutive calendar day that Final Completion is delayed in accordance with the Contract Agreement.

Enclosed herewith is the following Security, offered as evidence that the undersigned will enter into Agreement for the execution and completion of the work in accordance with the Drawings, Specifications and Project Manual:

Bidder's Bond or Cashiers Check in the amount of: \$_____

Bond Issued by or Name of Bank:_____

The undersigned hereby agrees, if awarded the contract, to execute and deliver to the City within ten (10) days after his receipt of the Notice of Award, a satisfactory contract bond as required in the amount of one hundred (100) percent of the Base Bid.

The undersigned further agrees that in case of failure on his part to execute the said Agreement within the ten (10) consecutive calendar days after written notice being given on the award of the contract, the monies payable by the Securities accompanying this bid shall be paid to the City of Lynchburg, Virginia, as liquidated damages for such failure; otherwise the Securities accompanying this Bid shall be returned to the undersigned.

Attached herewith is a Certified Anti-Collusion Statement. Failure to sign and notarize this statement may result in rejection of the Bid.

Attached herewith are completed Statement of Experience and Statement of Resources forms which include the information requested.

The undersigned further certifies that this bid is not the result of, or affected by, any act of collusion with another person engaged in the same line of business, or any act of fraud punishable under the Virginia Governmental Frauds Act.

This bid is subject to acceptance within a period of 90 days from this date.

Respectfully submitted,

DATE

CONTRACTOR

CURRENT CONTRACTOR'S VIRGINIA REGISTRATION NO.: _____

ADDRESS

BY:_____

TITLE:_____

ESCROW ACCOUNT ELECTION

If determined to be the successful low bidder(s), the above signed elects to use the Escrow Account Procedure.

Write "Yes" or "No" on above line

In the event the successful bidder elects to use the Escrow Account Procedure, the "Escrow Agreement" Form shall be executed and submitted to the City of Lynchburg Engineering Division within fifteen (15) calendar days after notification. If the "Escrow Agreement" Form is not submitted within the fifteen-day period, the contractor shall forfeit his rights to the use of the Escrow Account Procedure.

Company_____

Authorized Signature_____

EQUAL OPPORTUNITY REPORT STATEMENT

The Bidder shall complete the following statement by checking the appropriate blank as follows.

The Bidder has _____ has not _____ participated in a previous contract subject to the nondiscrimination clause prescribed by Executive Order 10925, dated March 6, 1961, or Executive Order 11114 dated June 22, 1963.

In conjunction with the City of Lynchburg's policy to utilize Minority and Disadvantaged Business Enterprises wherever possible, the Bidder has solicited quotations for labor, material and/or services from the following:

NAME OF FIRM	PERSON(S) CONTACTED	DATE
_____	_____	_____
_____	_____	_____
_____	_____	_____

Of those listed above, we intend, at this time, to utilize the following in the completion of the work required by this contract:

"This firm assures that it will give its best efforts to utilize Disadvantaged Business Enterprises whenever possible."

CERTIFIED BY: _____(Signature)
_____(Typed/Printed name & Title)

BIDDER'S NAME: _____

IRS NUMBER: _____

_____This firm shall perform all construction with its own employees and, therefore, is not required to solicit quotations from DBE's.

FAILURE TO DOCUMENT AND REPORT DBE CONTACTS ON THIS FORM MAY BE A BASIS FOR REJECTION OF THE BID AS NONCONFORMING.

CERTIFICATION OF NONDISCRIMINATION AND ANTI-COLLUSION

By submitting their bids, all bidders certify to the City of Lynchburg, VA that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, as well as the Virginia Fair Employment Contracting Act of 1975, as amended, where applicable, the Virginian's With Disabilities Act, the Americans With Disabilities Act, Section 2.2-4311 of the Virginia Public Procurement Act, and the Lynchburg Procurement Ordinance:

In every contract over \$10,000, the provisions below apply:

1. During the performance of this contract, the contractor agrees as follows:
 - A. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.
 - B. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer.
 - C. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.
2. The contractor will include the provisions of the foregoing paragraphs A, B and C in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

Certified by: _____ (corporate seal)

Date: _____

Note: I hereby certify that this bid is not the result of, or affected by, any act of collusion with another person engaged in the same line of business, or any act of fraud punishable under the Virginia Commonwealth Frauds Act.

_____ (seal)

Acknowledged before me this _____ day of _____, _____

Notary Public

My commission expires: _____

STATEMENT OF EXPERIENCE

Proposer: _____

How Long In Business: _____ *At Current Address:* _____

Principals: _____ *Title:* _____
_____ *Title:* _____
_____ *Title:* _____

Type of Work Normally Performed: _____

Projects of this type previously completed:

1. _____
_____ *Amount \$* _____
2. _____
_____ *Amount \$* _____
3. _____
_____ *Amount \$* _____

Reference (for Projects listed above):

1. _____
_____ *Tel. No.* _____
2. _____
_____ *Tel.No.* _____
3. _____
_____ *Tel. No.* _____

STATEMENT OF AVAILABLE RESOURCES

Equipment: _____

Number of Personnel Currently Employed: _____

Number of Personnel Available for Project: _____

Other Pertinent Information: _____

CORPORATE STATUS FORM

ALL PROSPECTIVE FIRMS MUST RESPOND TO THE FOLLOWING

If a limited liability company, limited liability partnership or a limited partnership indicate below:

- Check one: ☐ Limited liability company
- ☐ Limited liability partnership
- ☐ Limited partnership

Have you registered with the State Corporation Commission, to conduct business in Virginia?

☐ Yes ☐ No

Name and address of organizer: _____

List who is authorized to execute contracts: _____

If conducting business under an assumed business name, fill out the following information:

Name of assumed business: _____

Owner's name and address: _____

Registration date: _____ Expires: _____

If conducting business as a sole proprietorship, fill out the following information:

Individual's name liable for all obligations of business: _____

If you are a sole proprietor using an assumed name, please list below:

Registration date: _____ Expires: _____

INSURANCE REQUIREMENTS

The contractor/vendor shall procure, maintain, and provide proof of insurance coverage for injuries to persons or damages to property which may arise from or in connection with the work performed on behalf of the City by the contractor, his agents, representative, employees, or subcontractor. Such coverage shall be maintained by the contractor/vendor for the duration of the contract period.

Broad Form Commercial General Liability:

(Occurrence Form CG0001, Ed. 11/88):

\$1,000,000 CSL, BI &PD

Automobile Liability:

Code 1 "ANY AUTO" (Form CA0001 Ed. 6/92):

\$1,000,000 CSL, BI & PD

Workers' Compensation: Statutory Amount

Please state your ability to comply with these requirements

YES

NO

The insurance policies shall include or be endorsed to include the following provisions.

1. The City of Lynchburg, Virginia its officers/officials, employees, agents, and volunteers (the City), shall be added as “insureds” under the terms and conditions of the policies for liabilities which may arise out of the contractor/vendor’s operations or activities in these projects.
2. Any deductibles or self-insured retentions applicable to required coverages shall be paid by the contractor/vendor, and the City shall not be required to participate therewith.
3. The contractor/vendor shall agree to provide the City with 30 days written notice of any cancellation of or reduction in the required coverages.
4. The insurance required hereunder shall be primary and any insurance or self-insurance maintained by the City shall be excess of the contractors/vendor’s insurance and shall not contribute therewith.
5. Failure of the contractor/vendor to comply with any reporting provisions of the insurance policies required hereunder shall not affect coverage provided to the City.
6. All rights of subrogation against the City shall be waived.
7. The contractor/vendor shall provide the City with certificate of insurance with applicable endorsements effecting coverages, signed by a person authorized by the insurance company to bind coverage on its behalf. Certificates of insurance shall be received by the City within 5 days of notice of intent to award. Please state ability to comply _____.
8. All coverages for subcontractors of the contractor/vendors, if any, shall be subject to all of the requirements stated herein.

INSTRUCTIONS TO BIDDERS

DESCRIPTION OF WORK

The work included under this contract shall consist of all labor, materials, equipment, and the performance of all work necessary to complete the project known as “Carroll Avenue Pump Station Generator”. This work shall be performed in accordance with the project plans, specifications and Project Manual.

1. General: To be valid for consideration, bids must be completed and submitted in accordance with these instructions to bidders.
2. Bidding documents will be provided as indicated in the Advertisement.
3. Qualification of Bidders: Each bidder must be prepared to submit within five calendar days of the Owner’s request written evidence of their qualifications for the project including financial data, previous experience, and evidence of authority to conduct business in the jurisdiction where the project is located.
4. Examination of Bid Documents and Site:
 - 4.1 Before submitting bids, each bidder must examine bid documents thoroughly; familiarize themselves with Federal, State and local laws, ordinances, rules, and regulations affecting the work; and correlate their observations with requirements of the bid documents.
 - 4.2 Bidders are requested and expected to visit the site of the project to alert themselves to local and special conditions which may be encountered during construction of the project such as: Labor and transportation, handling and storage of materials, the availability of materials, and site access. Failure to make such investigations shall not relieve the successful bidder from performing and completing the work in accordance with the contract documents.
 - a. An optional pre-bid conference will be held at the time and place stated in the Advertisement.
5. Clarification:
 - 5.1 No oral clarification of the bid documents will be made to any bidder. To be given consideration, requests for clarification must be received in time to allow preparation of written response at least seven (7) days prior to date fixed for opening of bids. Clarifications will be issued in the form of written addenda to the bid documents and posted to the Procurement Website within five (5) days of the bid opening. Only clarification by formal written addenda will be binding.
 - 5.2 All communications in regard to clarifications and any other matters related to this project shall be addressed to: Stephanie Suter, Procurement Division, 900 Church Street, Lynchburg, VA 24504, Fax:434-845-0711, email: stephanie.suter@lynchburgva.gov

6. Substitutions:

6.1 Substitutions of material or equipment or both may be offered by the Contractor with his bid, provided that, if approved:

- a. No major changes in the construction or design intent of the project would be required. Changes required to accommodate substituted items shall be made by the Contractor at no additional cost or time delay.
- b. Features of quality, capacity, construction, performance, appearance, size, arrangement, and general utility including economy of operation of substitutes offered, either parallel or exceed those of specified products.
- c. The provisions of the General Requirements and any other guarantees, if required by the specification sections, shall apply in full force and effect to the performance of such substitute products, approved for incorporation into the Work.

6.2 Technical data covering the proposed substitution shall be furnished with the bid when possible, and not later than 10 days after bid submission.

7. Bid Submission:

7.1 Submit bids using forms furnished in the Project Manual and fill in all blank spaces on the form. Repeat notation "Contractor's Current Virginia License No. _____" on outside of inner envelope containing bid and bid security, and place this envelope within another envelope addressed to:

City of Lynchburg
Procurement Division
900 Church Street
Third Floor, City Hall
Lynchburg, VA 24504

Bidders shall include the following with their bid submission:

- Bid Form
- Statement of Experience
- Statement of Available Resources
- Equal Opportunity Report Statement
- Certification of Nondiscrimination and Anti-Collusion (failure to sign and notarize this statement may result in rejection of the bid)
- Insurance Requirements
- Corporate Status Form
- Bid Bond

7.2 Both the inner and outer envelopes shall have noted thereon:

- a. "Sealed Bid Enclosed for the Carroll Avenue Pump Station Generator";
- b. Project Number 04036-W;

- c. The bidder's name and address;
 - d. Repeat notation "Current Registered Virginia Contractor No. _____" on the outside envelope.
- 7.3 Each bid must be accompanied by a cashier's check on a bank satisfactory to the City or a Bid Bond in the amount of five percent (5%) of the amount of the total base bid, made payable to the City, as assurance that the successful bidder will enter into contract within ten (10) days after Notice of Award.

If the successful bidder default's by failure to enter into contract and filing applicable bonds, the certified check or Bid Bond accompanying the successful bid shall be collected by the City, not as a penalty but as liquidated damages for delays and such additional expenses as may be incurred by the City for reasons of such default.
- 7.4 Contractors will indicate a lump sum price for each item listed on the bid form. The total lump sum base bid shall contain all necessary cost required for completion of the item of work. Any changes, erasures, modifications, or deletions in the bid form, or alternate proposals not specified in the bid proposal shall make the proposal irregular and subject to rejection.
- 7.5 Receipt deadline for bids will be as stated in the Advertisement.
- 7.6 Bids will be opened publicly in accordance with Advertisement.
- 7.7 Withdrawal of bids after date for submission: In accordance with the provisions of sec. 2.2-4330 of the Virginia Public Procurement Act, a bidder will have two business days after the opening of bids within which to claim, in writing, any mistake as defined and withdraw their bid, provided such mistake be proved from the Contractor's work papers.
 - a. Definition: Contractor's work papers are the original work papers, documents, and materials used in the preparation of the bid as referred to in Section 2.2-4330 of the Virginia Public Procurement Act.
- 8. Bonds and Damages:
 - 8.1 Bonds shall be with a surety company acceptable to the Owner.
 - 8.2 A performance bond and a labor and material payment bond will be required in the amount of 100 percent of the bid.
 - 8.3 Liquidated damages shall be paid as indicated in the Bid Form.

9. Award of Contract:

- 9.1 The award of the contract will be to the responsible bidder submitting the lowest base bid whose qualifications indicate the award will be in the best interest of the Owner and whose bid meets the prescribed requirements.

Selection of the successful project contractor will include a serious evaluation of whether the competitor has conscientiously attempted to meet DBE goals. A requirement of the contract agreement will be that a genuine concerted effort will be utilized to meet the contract goal.

- 9.2 Before the contract is awarded, the Contractor submitting the lowest bid must satisfy the City that they have the requisite organization, capital, equipment, ability, personnel, and at least five years experience in municipal type work for which they have submitted a bid. Each bidder shall, with his bid, submit a list of at least five projects of similar size and dollar value completed within the last five years, giving location, dollar value, year completed, and the name(s) of the Owner(s) and Engineer(s). The Contractor shall verify to the City that it has the sufficient and qualified personnel to provide for the contract work. Failure by the lowest bidder to sufficiently satisfy the City of its ability to meet any of the above requirements will serve as grounds for rejection of the bid.

- 9.3 The Owner reserves the right to reject any and all bids and waive any and all informalities and the right to disregard all conforming, nonconforming, conditional bids or counterproposals.

- 9.4 Unless canceled or rejected, a responsive bid from the lowest responsible bidder shall be accepted as submitted, except that if the bid from the lowest responsible bidder exceeds available funds, pursuant to Section 18-158 of the Lynchburg Procurement Ordinance, the Owner may negotiate with the apparent low bidder to obtain a contract price within available funds.

- a. Procedures for Negotiations: If the Owner wishes to negotiate with the apparent low bidder to obtain a contract price within available funds, negotiations shall be conducted in accordance with the following procedures:

1. The using agency shall provide the Procurement Administrator, with a written determination that the apparent low bid exceeds available funds. Said determination shall be confirmed in writing by the Director of Finance or his designee. The using agency shall also provide the appropriate Procurement Administrator with a suggested reduction in scope for the proposed purchase.
2. The Procurement Administrator of the using agency shall advise the lowest responsible bidder, in writing, that the proposed purchase exceeds available funds. The Procurement Administrator shall further suggest a reduction in scope from the proposed purchase, and invite the lowest responsible bidder to amend its bid proposal based upon the proposed reduction in scope.

3. Repetitive informal discussions with the lowest responsible bidder for purposes of obtaining a contract within available funds shall be permissible.
 4. The lowest responsible bidder shall submit a written Addendum to its original bid, which Addendum shall include: The change in scope for the proposed purchase, the reduction in price, and the new contract value.
 5. If the proposed Addendum is acceptable to the Owner, the Owner may award a contract within funds available to the lowest responsible bidder based upon the amended bid proposal.
 6. If the Owner and the lowest responsible bidder cannot negotiate a contract within available funds, all bids shall be rejected.
- 9.5 Submission of post-bid information shall be in accordance with the contract documents.

End of Instructions to Bidders

SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

1.1. RIGHT TO TERMINATE

The performance of work under Contract may be terminated by the City upon written notice to the Contractor without cause, for any reason in whole or in part, whenever it is determined that such termination is in the City's best interest. In the event of such termination, the rights and obligations of the parties, which by their nature survive termination of services covered by a Contract, shall remain in full force and effect after termination. In the event of such termination the Contractor shall be paid for services rendered and approved up to the date of termination. The Contractor may submit any termination claim within 60 days after receipt of the notice of termination.

1.2. CONTRACTUAL CLAIMS

In accordance with Section 2.2-4363 of the Virginia Public Procurement Act, contractual claims, whether for money or other relief, shall be submitted in writing to the City Manager with copy to the Purchasing Agent, no later than sixty days after final payment. However, written notice of the contractor's intention to file such claim shall have been given within ten days of the occurrence of the event giving rise to the claim or the beginning of the work upon which the claim is based. Nothing herein shall preclude a contract from requiring submission of an invoice for final payment within a certain time after completion and acceptance of the work or acceptance of the goods. Pendency of claims shall not delay payment of amounts agreed due in the final payment.

The decision of the City Manager on the claim shall be final unless appealed to the Lynchburg Circuit Court as provided by law.

1.10. APPEALS PROCEDURES

In accordance with Sec.18-159 of the Lynchburg City Code, any bidder, offeror or Contractor may protest a decision to award or an award, appeal a decision to refuse to allow withdrawal of bids, appeal a decision of disqualification, debarment or a determination of non-responsibility, or appeal a decision on disputes arising during the performance of a contract.

Any protest or appeal pursuant to this section shall be in accordance with such administrative procedures as the City manager may prescribe.

Any bidder, offeror or Contractor shall submit a written protest or letter of appeal to the City Purchasing Agent with a copy to the City Manager, in the case of construction contracts, within the time constraints as set forth in the act. The written protest or appeal shall include the basis for the protest or appeal and the relief sought, and whether the bidder, offeror or Contractor wishes to have a hearing with respect to the protest or appeal.

If no hearing is requested, the City manager or his designee shall render a written decision to the bidder, offeror or Contractor within ten (10) days of receipt of the written protest or letter of appeal.

If a hearing is requested, it shall be held within (10) days of receipt of the written protest or letter of appeal, and a final decision shall be rendered within ten (10) days of the hearing. During the hearing, the protesting party shall have the opportunity to present pertinent information and to cross-examine adverse witnesses. The hearing shall be an informal administrative proceeding rather than a judicial-type trial, and a disinterested person, who may be a City employee, appointed by the City Manager, will conduct it.

The findings of fact shall be final and conclusive and shall not be set aside unless the same are fraudulent or arbitrary or capricious, or so grossly erroneous as to imply bad faith. No

determination on an issue of law shall be final if appropriate legal action is instituted in a timely matter.

Any party to the administrative procedure shall be entitled to institute judicial review if such action is brought within thirty (30) days of receipt of the written decision.

1.14 **GOVERNING LAW AND POLICY**

This Contract shall be governed by and construed in accordance with the laws of the Commonwealth of Virginia and the Lynchburg Public Procurement Ordinance. The successful Contractor submits itself to the jurisdiction of a Court of competent jurisdiction in the City of Lynchburg, Virginia and such Courts shall be the appropriate forums.

1.15 **RIGHT TO AUDIT**

All contracts are subject to audit by Federal, State or City Personnel or their representatives at no cost to the City. Contractor agrees to retain all records, books and other documents relevant to this Contract and the funds expended hereunder for at least four (4) years after Contract acceptance, or as required by applicable law. Requests for audits shall be made in writing and Contractor shall respond with all information requested within ten (10) calendar days of the date of the request.

CONTRACT BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____
(Hereinafter called the Principal) and _____
(Hereinafter called the Surety) are held and firmly bond unto the City of Lynchburg, a Municipal Corporation of the Commonwealth of Virginia (Hereinafter called the Owner) in the penal sum of

_____ DOLLARS
(\$ _____) for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns for the faithful performance of a certain written contract, dated the _____ day of _____, 20____, entered into between the Principal and City of Lynchburg, for _____ (project).

NOW, THEREFORE, the condition of this obligation is such that if the Principal shall faithfully perform the terms and conditions of the contract in all respects on his or its part and shall fully pay all obligations incurred in connection with the performance of such contractor on account of labor and materials used in connection therewith and all such obligations of every form, nature, and character, and shall save harmless the Owner from any and all liability of every nature, kind, and character which may be incurred in connection with the performance or fulfillment of such contract on the part of the Principal or other such liability resulting from negligence or otherwise on the part of the Principal, and further shall save harmless the Owner from all costs and damage which may be suffered by reason of the failure of the Principal to fully and completely perform said contract, and shall fully reimburse and repay the Owner for all expenditures of every kind, character, and description which may be incurred by the Owner in connection with making good any and every default which may exist on the part of the Principal in connection with the performance of said contract; and further that if the Principal shall pay all lawful claims of all persons, firms, partnerships or corporations for labor performed and materials furnished in connection with the performance of the contract (we agreeing that failure so to do shall give such persons, firms, partnerships or corporations a direct right of action against either the Principal or Surety under this obligation, or both said Principal and Surety), then this obligation shall be void, otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated;

PROVIDED HOWEVER, that this bond is issued subject to the following conditions and privileges:

1. That no suit, action or proceeding by reason of any default whatever on the part of the Principal shall be brought on this bond after one year from the date on which final payment on the contract falls due;
2. That any alterations or additions which may be made under the contract or the work to be done under it or the giving by the Owner of any extension of time for the performance of the Contract, or any other forbearance on the part of either the Owner or the Principal shall not in any way release the Principal and Surety, or either of them, their heirs, executors, administrator, successors or assigns, from their liability hereunder, notice to the Surety of any such alterations, extensions or forbearances being expressly waived.

Executed in two counterparts.

IN WITNESS WHEREOF, _____, the Principal, has caused its name to be hereunto subscribed and its corporate seal to be hereunto affixed and duly attested by its proper officers heretofore duly authorized this _____ day of _____, 20____, and the Surety has caused its name to be hereunto subscribed and its seal affixed by its authorized Attorney-in-Fact.

BY: _____
President

(SEAL)

ATTEST:

Secretary

BY: _____
Attorney-in-Fact

DIVISION 16

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SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1- GENERAL

1.1 SUBMITTALS

- A. Product data including manufacturer's technical data, specifications, and installation instructions.

PART 2 - PRODUCTS

2.1 FABRIC

- A. Comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" with 2-inch mesh of 0.148-inch-diameter (9-gage), galvanized (zinc coated) steel wire.
- B. Fabric shall be 7'-0" high.

2.2 PIPE

- A. Type: Standard weight (Schedule 40) galvanized steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F699, Group 1A, with minimum yield strength of 25,000 psi, not less than 1.8 ounce of zinc per square foot. Type A coating inside and outside according to ASTM F1234, as determined by ASTM A90. Weight per foot shall be as follows:

<u>Actual OD</u>	<u>Weight (lb/ft)</u>	<u>NPS Size</u>
1.660	2.27	1-1/4
1.900	2.72	1-1/2
2.375	3.65	2
2.875	5.79	2-1/2

2.3 POSTS AND RAILS

- A. Top rail: 1.66-inch OD pipe.
- B. Line or Intermediate Posts: 2.375-inch OD pipe.
- C. End, Corner, and Pull Posts: 2.875-inch OD pipe.
- D. Swing Gate Posts: 2.875-inch OD pipe.
- E. Fittings and Accessories: Comply with ASTM F 626.

- F. Post and Line Caps: Provide weathertight cap for each post. Provide line post caps with loop to receive tension wire or top rail.
- G. Post Brace Assembly: Same material as top rail with 3/8-inch-diameter rod and adjustable tightener.
- H. Center Rail: Same material as top rail with cap on each end.
- I. Tension or Stretcher Bars: Galvanized steel bar, 2 inches shorter than fabric height, 3/16 inch thick by 3/4 inch wide.
- J. Tension and Brace Bands: 3/4-inch-wide galvanized-steel bands.
 - 1. Tension Bands: 0.074 inch thick (14 gage).
 - 2. Brace Bands: 0.105 inch thick (12 gage).
- K. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire with finish to match fabric.
- L. Tie Wires: 0.106-inch-diameter (12-gage) galvanized steel or 0.148-inch-diameter (9-gage) aluminum alloy wire to match fabric wire.

2.4 SWING GATES

- A. Comply with ASTM F 900.
- B. Fabric: Same as fence.
- C. Frames: 1.90-inch OD pipe.
- D. Hardware: Provide galvanized hardware and accessories for each gate according to the following:
 - 1. Hinges: Non-lift-off type, offset to permit 180-degree gate opening.
 - 2. Latch: Forked type or plunger-bar type with padlock eye.
 - 3. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
 - 4. Gate Stops: Provide gate stops set in concrete for double gates, designed to engage a center drop rod or plunger bar. Include a locking device permitting both gate leaves to be locked with a single padlock.

2.5 BARBED WIRE

- A. Barbed Wire Supporting Arms: Manufacturer's standard barbed wire supporting arms conforming to ASTM F 626, metal and finish to match fence framework, with provision for anchorage to posts and attaching three rows of barbed wire to each arm. Supporting

arms may be either attached to posts or integral with post top weather cap and must be capable of withstanding 250-lb downward pull at outermost end. Provide following type:

- B. Single 45-degree arm for three strands of barbed wire, one for each post.
- C. Steel Barbed Wire: Two-strand, 0.099-inch-diameter (12-1/2-gage) steel wire with 0.080-inch-diameter (14-gage), four-point barbs spaced not more than 5 inches o.c.. Finish shall be galvanized complying with ASTM A 121, chain link fence grade with Class 3 coating with not less than 0.8 oz. of zinc per sq. ft. as determined by ASTM A 90.

2.6 Epoxy grout shall be Sika Corporation, Sikadur 35, H:-ModLV.

PART 3 - EXECUTION

3.1 INSTALLATION: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted. Apply fabric to outside of framework.

3.2 EXCAVATION

- A. Drill postholes to diameters and spacings indicated.
- B. Excavate post hole diameter to four times the largest cross section of post and hole depth, approximately 3 inches below bottom of posts, with bottom of posts set not less than 36 inches below finish grade surface.

3.3 SETTING POSTS

- A. Center and align posts in holes 3 inches above bottom of excavation.
- B. Space posts not more than 10 feet o.c.
- C. Align posts vertically and align tops.
- D. Extend concrete footings 2 inches above grade and trowel to a crown to shed water.
- E. Setting Posts:
 - 1. Set posts in sleeves provided in concrete slab.
 - 2. Fill voids between post and inside of sleeve with epoxy grout.
- F. Top Rails: Run rail continuously through line post caps with expansion couplings as recommended by fencing manufacturer.
- G. Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts so posts are plumb when diagonal rod is under proper tension.
- H. Bottom Tension Wire: Install within 6 inches of bottom of fabric and tie to each post. Fasten to fabric with 0.120-inch-diameter (11-gage) hog rings spaced not more than 24 inches o.c.

- I. Fabric: Install fabric on security side of fence with approximately 2 inches between finish grade and bottom selvage and anchor to framework so that fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure bars to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.
- K. Tie Wires: Use to secure fabric to posts and rails. Tie fabric to line posts 12 inches o.c. and to rails and braces not more than 24 inches o.c.
- L. Barbed Wire: Pull wire taut and install securely to extension arms and secure to end post or terminal arms according to manufacturer's instructions.
- M. Gates: Install gates according to manufacturer's instructions, plumb, level, and secure for full opening without interference.

END OF SECTION 02831

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

- 1.01 SUBMITTALS: Submit the following: Product data for reinforcement, forming accessories, admixtures, and curing compounds.

Shop drawings for fabricating, bending, and placing concrete reinforcement.

Laboratory test reports or evaluation reports for concrete materials and concrete mix designs.

PART 2 - PRODUCTS

- 2.01 FORM MATERIALS: Furnish form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

A. Forms for Exposed Concrete Surfaces: Suitable panel-type material to provide continuous, straight, smooth, exposed surfaces.

- 2.02 REINFORCING MATERIALS: As follows:

A. Deformed Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.

- 2.03 CONCRETE MATERIALS: As follows:

A. Portland Cement: ASTM C 150, Type 1.

B. Fly Ash: ASTM C 618, Type F.

C. Aggregates: ASTM C 33, except local aggregates of proven durability may be used when acceptable to Architect.

D. Water: Potable.

- 2.04 ADMIXTURES: Provide admixtures that contain not more than 0.1 percent chloride ions.

A. Air-Entraining Admixture: ASTM C 260.

B. Water-Reducing, Retarding, and Accelerating Chemical Admixtures: ASTM C 494.

- 2.05 RELATED MATERIALS: As follows:

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

B. Moisture-Retaining Cover: Waterproof paper, polyethylene film, or polyethylene-coated burlap, complying with ASTM C 171.

- C. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
- 2.06 MIX PROPORTIONS AND DESIGN: Proportion mixes complying with mix design procedures specified in ACI 301.
- A. Limit use of fly ash to not exceed 25 percent of cement content by weight.
 - B. Design mixes to provide normal weight concrete with the following properties:
 - 1. 4000-psi, 28-day compressive strength; water-cement ratio, 0.44 maximum (non-air-entrained), 0.35 maximum (air-entrained).
 - C. Limit maximum water-cement ratio of concrete exposed to freezing and thawing to 0.45. Limit maximum water-cement ratio of concrete exposed to deicing salts, brackish water, or seawater to 0.40.
 - D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps, Slabs, and Sloping Surfaces: Not more than 3 inches.
 - 2. Reinforced Foundation Systems: Not less than 1 inch and not more than 3 inches.
 - 3. Other Concrete: Not more than 4 inches.
 - E. Adjust mix designs when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until laboratory test data and strength results have been submitted to and reviewed by Architect.
- 2.07 Use air-entraining admixture in exterior exposed concrete, providing not less than 4.5 percent nor more than 7 percent entrained air for concrete exposed to freezing and thawing, and from 2 percent to 4 percent for other concrete.
- 2.08 Use water-reducing, accelerating, and retarding admixtures that have been tested and accepted in mix designs in strict compliance with manufacturer's directions.
- 2.09 Job-Site Mixing: Use drum-type batch machine mixer, mixing not less than 1-1/2 minutes for 1 cu. yd. or smaller capacity. Increase mixing time at least 15 seconds for each additional cu. yd.
- 2.10 Ready-Mix Concrete: ASTM C 94.

PART 3 - EXECUTION

- 3.01 CONSTRUCT GENERATOR PAD as recommended by generator manufacturer and per the VUSBC for the seismic zone in which the project is located.
- 3.02 FORMWORK: Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position. Select form materials to obtain required finishes.
-

- A. Maintain formwork tolerances and surface irregularities within ACI 347 limits, Class A tolerances for concrete exposed to view and Class C tolerances for other concrete surfaces.
 - B. Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.
 - C. Clean and adjust forms prior to concrete placement. Apply form-release agents or wet forms as required. Retighten forms during concrete placement, if required, to eliminate mortar leaks.
- 3.03 REINFORCEMENT: Accurately position and support reinforcement, and secure against displacement. Locate and support reinforcement to maintain minimum cover with metal chairs, runners, bolsters, spacers, and hangers as required. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- 3.04 JOINTS: Locate and install construction, isolation, and control joints as indicated or required. Locate construction joints so they do not impair strength and appearance of structure. Place isolation and control joints in slabs-on-ground to stabilize differential settlement and prevent random cracking.
- 3.05 CONCRETE PLACEMENT: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," for placing concrete in a continuous operation within planned joints or sections. Do not begin concrete placement until other affected work is completed.
- A. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping so that concrete is worked around reinforcement and other embedded items and into forms.
 - B. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
 - 1. In cold weather comply with ACI 306.
 - 2. In hot weather comply with ACI 305.
- 3.06 MONOLITHIC SLAB FINISHES: As follows:
- A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish when surface water has disappeared and when concrete has stiffened sufficiently to permit operation of power-driven floats. Consolidate surface with power-driven floats or by hand-floating.
 - 1. Check and level surface plane to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness). Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

- B. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.
- 3.07 CURING: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, apply an evaporation-control compound according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- A. Begin initial curing as soon as free water has disappeared from exposed surfaces.
 - B. Continue curing unformed concrete surfaces by water ponding, continuous fog spraying, continuously wetted absorptive cover, or by moisture-retaining cover curing. Cure formed surfaces by moist curing until forms are removed. Keep concrete continuously moist for not less than 72 hours for high- early strength concrete and 7 days for all other concrete.

END OF SECTION 03300

SECTION 16010

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. Each Section within Division 16 - Electrical, shall conform to the requirements of the General Conditions of the Contract, including Supplementary General Conditions, Special Conditions, and all requirements of Division 1.
- B. Each Section within Division 16 - Electrical, shall conform to the additional requirements of this Section, Electrical General Provisions.

1.2 REFERENCE STANDARDS

- A. Material, equipment and installation shall meet requirements of applicable codes and standards listed below. Electrical material and equipment shall bear the UL label except where UL does not label such types of material and equipment.
- B. Reference standards are referred to by abbreviation as follows:
 - 1. American National Standards Institute ----- ANSI
 - 2. American Society for Testing and Materials ----- ASTM
 - 3. National Electrical Code (NFPA No. 70) ----- NEC
 - 4. National Electrical Manufacturers Association ----- NEMA
 - 5. National Electrical Testing Association ----- NETA
 - 6. National Fire Protection Association ----- NFPA
 - 7. Underwriters Laboratories, Inc. ----- UL
 - 8. Virginia Uniform State Building Code----- USBC

- 1.3 RECORD DRAWINGS: Maintain a dedicated set of drawings on the jobsite and mark all variations taken to the Contract Drawings.

1.4 INTENT OF DRAWINGS AND SPECIFICATIONS

- A. The implied and stated intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide an operable electrical system complete in every respect.
- B. The drawings are diagrammatic, intending to show general arrangement and location of system components, and are not intended to be rigid in detail.

- C. Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets and fittings may not be shown but shall be provided at no change in Contract Price.

1.5 SUBMITTALS

- A. Submit Shop Drawings in accordance with the General Conditions and Supplementary Conditions.
- B. Shop Drawings shall be presented in a clear and thorough manner.
- C. Prepare shop drawings as follows:
 - 1. Clearly mark each copy to identify pertinent products or models.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions and clearances required.
 - 4. Show wiring diagrams and controls.
- D. Manufacturer's standard schematic drawings and diagrams:
 - 1. Modify drawings and diagrams to delete information which is not applicable to the work.
 - 2. Supplement standard information to provide information specifically applicable to the work.
- E. The Contractor shall:
 - 1. Review Shop Drawings prior to submission.
 - 2. Determine and verify:
 - a. Field measurements.
 - b. Field construction criteria.
 - c. Catalog numbers and similar data.
 - d. Conformance with specifications.
 - 3. Coordinate each submittal with requirements of the work and of the Contract Documents.
 - 4. Notify the Engineer in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.

5. Begin no fabrication or work which requires submittals until return of submittals with Engineer approval.
 6. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other trade.
- F. Unless required otherwise by the General Conditions, or the Supplementary Conditions, submit the number of opaque reproductions which the Contractor requires, plus two copies which will be retained by the Engineer.
- G. Submittals shall contain:
1. The date of submission and the dates of any previous submissions.
 2. The Project title and number.
 3. Contract identification.
 4. The names of:
 - a. Contractor.
 - b. Supplier.
 - c. Manufacturer.
 5. Identification of the product, with the specification section number.
 6. Field dimensions, clearly identified as such.
 7. Relation to adjacent or critical features of the work or materials.
 8. Applicable standards.
 9. Identification of deviations from Contract Documents.
 10. Identification of revisions on resubmittals.
 11. Copy of Shop Drawing Review Stamp Sheet as found in Paragraph 4 of this Section with Electrical Contractor's section executed certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 12. Each submittal shall be limited to a single specification section. Submittals shall not be grouped with other sections in common binders or under common control sheets. Each submittal shall have a cover/control sheet containing the information listed above (1 thru 11).

- 13. Submittals which do not comply with these requirements may be returned with no action taken at the reviewer's discretion.
- H. The Contractor shall distribute approved samples per Division 1 - General Requirements.
- I. Submit shop drawings for the following identified by section number and product name:
 - 16420 - Electric Service
 - 16440 - Safety Switches
 - 16450 - Grounding
 - 16470 - Panelboards
 - 16475 - Molded Case Circuit Breakers (MCCB)
 - 16480 - Motor Starters
 - 16617 - Surge Suppressors
 - 16620 - Emergency Standby Power System
 - 16625 - Emergency Standby Power Automatic Transfer Switch (ATS)
- 1.6 CUTTING AND PATCHING: Shall be done in a workmanlike manner using tools and materials suitable for the purpose.
- 1.7 OPERATING AND MAINTENANCE DATA
 - A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
 - B. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems.
 - C. Preparation of data shall be done by personnel:
 - 1. Trained and experienced in maintenance and operation of described products.
 - 2. Familiar with requirements of this Section.
 - 3. Skilled as technical writer to the extent required to communicate essential data.
 - 4. Skilled as draftsman competent to prepare required drawings.
 - D. Prepare data in form of an instructional manual for use by Owner's personnel.
 - E. Format:
 - 1. Size: 8 1/2 in. x 11 in.
 - 2. Paper: 20 pound minimum, white, for typed pages.
 - 3. Text: Manufacturer's printed data, or neatly typewritten.

4. Drawings:
 - a. Provide reinforced punched binder tab, bind in with text.
 - b. Fold larger drawings to size of text pages.
 5. Provide fly-leaf for each separate product, or each piece of operating equipment.
 - a. Provide typed description of product, and major component parts of equipment.
 - b. Provide indexed tabs.
 6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - a. Title of Project.
 - b. Identity of separate structure as applicable.
 - c. Identity of general subject matter covered in the manual.
- F. Binders:
1. Commercial quality three-ring binders with durable and cleanable plastic covers.
 2. Minimum ring size: 1 inch.
 3. When multiple binders are used, correlate the data into related consistent groupings.
- G. Manual shall contain a neatly typewritten table of contents for each volume, arranged in systematic order.
1. Contractor, name of responsible principal, address and telephone number.
 2. A list of each product required to be included, indexed to content of the volume.
 3. List, with each product, name, address and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify area of responsibility of each.
 - d. Local source of supply for parts and replacement.
 4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

- H. Product Data:
 - 1. Include only those sheets which are pertinent to the specific product.
 - 2. Annotate each sheet to:
 - a. Clearly identify specific product or part installed.
 - b. Clearly identify data applicable to installation.
 - c. Delete references to inapplicable information.
- I. Drawings:
 - 1. Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - 3. Do not use Project Record Documents as maintenance drawings.
- J. Written text, as required to supplement product data for the particular installation:
 - 1. Organize in consistent format under separate headings for different procedures.
 - 2. Provide logical sequence of instructions for each procedure.
- K. Copy of each warranty, bond and service contract issued.
 - 1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in event of failure.
 - b. Instances which might affect validity of warranties or bonds.
- L. Submit two copies of complete manual in final form.
- M. Submit operating and maintenance data on the following:
 - 16620 - Emergency Standby Power System
 - 16625 - Emergency Standby Power Automatic Transfer Switch (ATS)

PART 2- PRODUCTS

2.1 NAMEPLATES

A. Material:

1. Equipment nameplates shall be constructed of laminated phenolic with a black center core sandwiched between white layers.
2. Warning nameplates shall be constructed of laminated phenolic with a white center core sandwiched between red layers.

B. Inscription: Letters shall be engraved in the phenolic to form letters 3/8 inches high, unless indicated otherwise on drawings.

C. Fasteners shall be screws or a nonadhesive type fastener.

PART 3 - EXECUTION

- 3.1 All electrical work shall be performed by or under the direct supervision of a master electrician licensed to work in the project location.
- 3.2 Provide equipment connections complete with protective devices, wiring, and other accessories. All equipment and connections shall be as recommended by the manufacturer or as indicated on drawings or required by specifications.
- 3.3 Mount on each piece of equipment, a nameplate descriptive of the equipment or equipment controlled.
- 3.4 When equipment is supplied with electrical requirements other than those specified or shown on the drawings, associated electrical devices and circuitry of the correct sizes and ratings shall be provided.
- 3.5 Instruct Owner personnel in proper operation and maintenance of equipment.

PART 4.0 - SHOP DRAWING REVIEW STAMP SHEET

- 4.1 See following page.

ELECTRICAL CONTRACTOR'S SHOP DRAWING REVIEW	
PROJECT NO.:	
PROJECT NAME: Carroll Avenue Pump Station Generator	
SPECIFICATION SECTION	
APPROVED <input type="checkbox"/>	APPROVED AS NOTED <input type="checkbox"/>
ELECTRICAL CONTRACTOR'S COMPANY NAME: _____	
By: _____ Date: _____	

ENGINEER'S SHOP DRAWING REVIEW	
PROJECT NO.: 262-162-A	
PROJECT NAME: Carroll Avenue Pump Station Generator	
SPECIFICATION SECTION	
APPROVED <input type="checkbox"/>	APPROVED AS NOTED <input type="checkbox"/>
NOT APPROVED <input type="checkbox"/>	REVISE & RESUBMIT <input type="checkbox"/>
<p>Approval is only for conformance with the design concept of the project and compliance with the information given in the Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at the job site; for information that pertains solely to the fabrication process or to techniques of construction; and for coordination of the work of all trades.</p> <p>Master Engineers and Designers, P.C.</p> <p>By: _____ Date: _____</p>	

END OF SECTION 16010

16020

COORDINATION

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 DESCRIPTION

- A. Reasonable design effort has been made to coordinate the trades involved. Field coordination shall be the responsibility of all subcontractors on this project. Coordinate all portions of electrical work with that of other trades.

1.3 QUALITY ASSURANCE

- A. Arrange equipment substantially as shown on the drawings. Make deviations only where necessary to avoid interference. Check equipment size against available space prior to shipment to avoid interference.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

- 3.1 Because equipment supplied may have connection points different than shown on the drawings, locate conduit runs and locations of disconnects, control stations and the like based upon shop drawings of the associated equipment.
- 3.2 Where conflicts occur, bring to attention of the Engineer for resolution. Make adjustments as directed at no additional cost.
- 3.3 In all cases, locate equipment so that working clearances, clear space, access to equipment and headroom conforms to the requirements of National Electrical Code paragraphs 110-26 and 110-34.

END OF SECTION 16020

SECTION 16030

REWORKING EXISTING SYSTEM

PART 1- GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 DESCRIPTION

- A. Make indicated changes to existing facilities and equipment. Where indicated changes to nonelectrical facilities require minor associated electrical changes, these changes shall be accomplished even if not specifically indicated.
- 1.3 Provide material and labor necessary for temporary electrical facilities required to maintain facility in full operation for the duration of the project.

PART 2 - PRODUCTS

- 2.1 Products shall be new and as specified in this Division unless reuse of existing facilities is specifically indicated on the drawings.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING PREMISES

- A. Protect the existing premises, including the buildings, grounds and appurtenances, from damage which might be done or caused by work performed under this DIVISION. Repair damage so as to restore the damaged areas to their original condition.
- B. Provide protective materials and coverings where necessary, to guard building surfaces and building contents from damages due to the operations of this work.

3.2 MAINTENANCE OF EXISTING PREMISES

- A. During the execution of the work of this DIVISION the Owner will continue to occupy the existing building and will therefore require continuous operation of all existing facilities. Schedule outages required for construction purposes for the shortest practical periods of time, and then only by pre-arrangement with the Owner for specific, mutually agreeable periods, after each of which the interruption shall cease and service shall be restored.
- B. Perform work under this DIVISION in such a manner as to cause the least amount of interruption of existing services to the occupied spaces.

- C. Outages required to be performed outside of normal working hours in order to meet the project schedule shall be performed without additional cost to the Owner.

3.3 MAINTENANCE OF EXISTING FACILITIES

- A. Perform all work, including any alterations or modifications to the existing system, as may be necessary to provide a complete and usable facility in accordance with the design concept and as shown on the drawings.
- B. Perform alterations to existing electrical work as indicated on the drawings. Where making provisions to provide for continuous service, rewire subject outlets, devices and circuits in accordance with good workmanship by rerouting conduits, wiring and relocating devices and equipment to new locations as a part of the work to be performed under this DIVISION. In the removal of those outlets, devices or circuits that are not to be retained, remove all portions of such circuits in their entirety where possible. Where they are completely inaccessible, they may be abandoned, provided that the circuits, devices or equipment have been disconnected and de-energized from all power sources.

3.4 ELECTRICAL DEMOLITION

- A. Disconnect and remove all electrical materials and equipment within the construction limits indicated to be removed.
- B. Coordinate all phasing of demolition work with the Owner's representative to minimize interruption of power and the functioning of surrounding spaces.
- C. Disconnect and remove cable and conduit to equipment being removed.
- D. Cut back exposed portions of abandoned, concealed conduit to facilitate patching.
- E. See related paragraphs of this SECTION and other DIVISIONS for additional requirements.
- F. Dispose of removed equipment and material.
- G. Update nameplates of equipment from which circuits have been modified or disconnected.

- 3.5 Thoroughly inspect electrical systems in reworked areas and bring to the attention of the Engineer all defective or unserviceable material not scheduled for removal or replacement.

END OF SECTION 16030

SECTION 16040

TESTING AND PLACING IN SERVICE

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 WORK INCLUDES

- A. Provide all material, equipment, labor, and technical supervision to perform and complete the electrical acceptance tests in accordance with the requirements of this section for equipment installed as the work of this contract. Notify Engineer at least 7 working days in advance of tests.
- B. Perform tests on the following equipment:
 - 1. Grounding
 - 2. Motors
 - 3. Generators
 - 4. Transfer Switch
 - 5. Receptacles

1.3 REFERENCES

- A. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

1.4 SUBMITTALS

- A. Prior to beginning testing, submit for Engineer review, an outline of the test program for each piece of equipment. The form shall include the following information:
 - 1. Name of equipment and location within the facility
 - 2. Manufacturer and catalog number of the equipment
 - 3. Drawing number of the equipment
 - 4. Date of the test
 - 5. Time of the test

6. Temperature, degrees F
 7. Relative humidity, percent
 8. List of testing devices used (manufacturer and catalog number shall be shown)
 9. The test program for each individual piece of equipment, preferably in tabulation form
 10. Failures: Describe each failure in detail and the corrective measures taken. If no failures were observed, write "None "
 11. Certify readiness of the equipment for service
 12. Date, printed name, and signature of a person conducting the test and name of the person's employer
 13. Printed name, signature, name of the company of a person responsible for the start-up.
- B. Records of all tests and inspections, with complete data on all readings taken, shall be made and incorporated into a legible report. Four bound copies of all test reports shall be delivered to Engineer at the end of test period.
- 1.5 QUALITY ASSURANCE: Final acceptance will depend upon successful completion of specified testing.
- 1.6 Perform all tests in accordance with manufacturer's recommendations. Should manufacturer's recommendations conflict with these specifications, notify Engineer. Do not proceed with tests until directed by Engineer.
- 1.7 Material or equipment failing tests shall be repaired or replaced at the Contractor's expense.
- 1.8 The Contractor shall be responsible for all tests and test records. Testing shall be performed by or under the immediate supervision of the Contractor.
- 1.9 Inspect the equipment prior to energizing.
- 1.10 Notify vendors of equipment and invite the vendor to witness the test on equipment being tested under this specification. Extend reasonable cooperation to permit witnessing by a representative of the vendor of the equipment under test should the vendor so request.

PART 2- PRODUCTS

- 2.1 The Contractor shall employ, as a minimum, the testing devices listed below and personnel trained in their use. Items in parenthesis shall be maintained on the job site for the duration of the project.
- A. Phase sequence and motor rotation indicator: Amprobe Model PRM01, or equal.

- B. Megohmmeter: Amprobe Model Series AMB, or equal.
- C. Ground tester: Amprobe Model GP-1, or equal.
- D. Power-line disturbance analyzer: Dranetz Series 606.
- E. Resistance / inductance load bank
- F. Receptacle polarity tester: Bryant 5266PT, or equal.

PART 3 – EXECUTION

3.1 GENERAL

- A. The insulation tests (megger tests) as specified in this section are the minimum readings desired at an ambient temperature of 60 degrees F and a low relative humidity. Megger readings taken at other than ambient temperature of 60 degrees F shall be corrected to 60 degrees F. When megger readings fall below the specified minimum values, utilize recognized means to dry out the equipment. The method utilized by the Contractor must be in accordance with manufacturer's written instructions. If drying is to be done by applying an electric potential to a piece of equipment, then, in no case, induced or direct, shall the voltage or current exceed the continuous rating of the equipment being dried.

3.2 GROUNDING

- A. Measure the resistance (relative to earth) of each electrical equipment ground brought up from the underground grid.
- B. Do not measure outside ground rod and ground grid resistances to earth during unusually wet weather.

3.3 MOTORS

- A. Inspect all motors for phase identification.
- B. Check proper rotation.

3.4 TRANSFER SWITCH

- A. With all cables disconnected, test the switch insulation with a megger. The minimum acceptable megger reading shall be 100 megohms. Record megger reading and ambient air temperature and humidity.
- B. Manually and automatically operate switch to ascertain that correct and positive operation, interlocking and alarm have been achieved.

- 3.5 PHASE MATCHING AND PHASE ROTATION: Check phase matching and phase rotation immediately prior to energizing of equipment.

3.6 GENERATOR

- A. Perform a megger test on the generator.
 - 1. Perform test with the windings at ambient temperature. Dry and retest any machine not passing this test until it either passes or is found unsatisfactory.
 - 2. Test Procedure
 - a. Apply megger tests between all phases tied together and ground.
 - b. Maintain megger tests for 1 minute or until the reading maintains a constant value for 15 seconds.
 - c. Record all megger readings and ambient temperature at the time of test.
- B. Operational Test
 - 1. Test the equipment to show it will start automatically, pick up and serve full load, shut down and reset.
 - 2. Utilize a resistance / inductance load bank for the test. Load bank load rating shall equal or exceed the kw rating of the generator and shall have sufficient inductance to develop an 80% PF (power factor) load.
 - 3. Initial testing: With a power-line disturbance analyzer monitoring the output of the generator,
 - a. Start the generator and, utilizing the load bank, operate at 25% of rated load (80% PF) for a period not less than 2 hours.
 - b. Increase the load to 50% of rated load (80% PF) and operate for two more hours.
 - c. Increase the load to 100% (80% PF) and hold continuously for a period of not less than two hours.
 - d. Unload the machine and allow it to run under no-load conditions for at least 15 minutes.
 - e. Apply a full 100% step load (80% PF) and hold for a period of not less than 15 nor more than 30 minutes.
 - f. Stop the unit and allow it to cool to ambient temperature.
 - 4. Cold startup test: With a power-line disturbance analyzer monitoring the output of the generator,

- a. Start the generator and, using the load bank, apply a full 100% step load (80% PF) and hold for a period of not less than 15 nor more than 30 minutes.
 - b. Stop the unit, disconnect the load bank and connect the generator to the transfer switch.
 - c. Simulate a power failure and allow the generator to start automatically and pick up the transfer switch load.
 5. To pass these tests, the generator shall maintain the voltage and frequency specified as proven by the power-line disturbance analyzer printout.
 6. If malfunctions occur, take corrective action and repeat the tests until the unit functions as specified.
 7. Fuel utilized for testing shall be replaced at no additional cost to the Owner. After successful completion of testing, fill fuel system to maximum capacity.
 - C. Final acceptance of the generator will be made after the equipment is successfully energized during operational tests.
- 3.7 WIRING DEVICES: Using polarity tester, check polarity of each receptacle.

END OF SECTION 16040

SECTION 16110

METALLIC RACEWAYS

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES: ANSI PUBLICATIONS

- A. C80.1 Rigid Steel Conduit, Zinc Coated

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT (RSC)

- A. Low carbon, hot-dipped galvanized inside and outside, with threaded ends, minimum size 3/4 inch. Threaded fittings - cast iron or alloy steel, galvanized.

2.2 LIQUID TIGHT FLEXIBLE METAL CONDUIT

- A. Sealtite Type U.A. by Anaconda, Liqueflex Type LA by Electri-flex Company, Type GU by International Metal Hose Company, or Sealflex-U by Universal Metal Hose Company. Fittings shall be Thomas & Betts Series 6000.

2.3 CONDUIT BUSHINGS

- A. Insulated
 - 1. Type B, by O-Z / Gedney
 - 2. Series 1100, by Raco
 - 3. Series BU500, by Steel City
- B. Grounding:
 - 1. O-Z / Gedney Type BLG
 - 2. Raco series 1222 thru 1236
 - 3. Steel City Type BG.

2.4 THREAD LUBRICANT / SEALANT: Shall be Crouse-Hinds Type STL or equal by Ideal or O-Z / Gedney.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Install rigid steel conduit indoors and outdoors above ground.
- B. Install liquid-tight flexible metal conduit for connections to motors and other equipment subject to vibration.

3.2 CONDUIT INSTALLATION:

- A. Cut all conduit with hacksaw or approved cutting machine and ream after threading to remove all burrs.
- B. Arrangement
 - 1. Space groups of conduits uniformly. For bends and offsets, use an approved hickey or bending machine.
 - 2. Install runs of conduit parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.
 - 3. Provide right angle turns consisting of fittings or symmetrical bends.
 - 4. Avoid condensation pockets in installations.
 - 5. Not more than one exposed conduit shall be run down to an exposed wall switch or outlet box.
- C. Join conduit with approved couplings. No running threads will be allowed.
- D. Keep conduit, fittings, and boxes free from foreign matter, before, during, and after installation.

3.3 CONNECTION OF CONDUIT TO SHEET METAL BOXES AND ENCLOSURES:

- A. Fasten conduit securely to ensure electrical continuity of the raceway system.
- B. Install insulated bushings and sealing locknuts or hubs.

3.4 CORROSION PROTECTION: Apply thread lubricant / sealant to joints of all conduit.

END OF SECTION 16110

SECTION 16112

NONMETALLIC RACEWAY

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES

- A. NEMA TC-2 Electrical Plastic Tubing and Conduit.
- B. NEMA TC-3 PVC Fittings for use with Rigid PVC Conduit and Tubing.
- C. NEC Article 347 - Rigid Nonmetallic Conduit.
- D. UL 651 Rigid Nonmetallic Electrical Conduit.
- E. UL 514 Electrical Outlet Boxes and Fittings.
- F. ASTM D 2564 Solvent Cements for PVC Plastic Pipe and Fittings.

PART 2 - PRODUCTS

- 2.1 SCHEDULE 40 ELECTRICAL PLASTIC CONDUIT: Designed for underground installation without concrete encasement and normal duty application above ground and made of polyvinyl chloride (EPC-40-PVC for Type II and III applications). Minimum size shall be 3/4".
- 2.2 PVC PLASTIC FITTINGS: Designed to be joined in the field by means of a solvent cement system.
- 2.3 SOLVENT CEMENT: ASTM D 2564 or in accordance with raceway manufacturer's printed recommendations.
- 2.4 CLAMPS, STRAPS, WALL HANGERS, AND OTHER HARDWARE: Nylon, PVC or PVC-coated to provide the same corrosion resistance as the raceway.

PART 3 - EXECUTION

- 3.1 APPLICATION: Install EPC-40-PVC when PVC conduit is indicated on the drawings without further definition.
- 3.2 CONDUIT CONNECTION
 - A. Join raceway by means of solvent cement in accordance with the suggested methods indicated in the appendix of NEMA TC-2 for "normal" service conditions.

- B. Install socket type couplings for joining raceway.
- C. Install female adapters with female threads on one end and socket end on the other for adapting nonmetallic raceway to threaded metallic raceway.
- D. Install terminal adapters for adapting nonmetallic raceway to boxes, threaded fitting, and metallic systems. Male threads on one end, socket end on the other. Secure with locknut.

3.3 BENDS

- A. Bends shall be made with factory elbows or with electric heaters designed specifically for the purpose. The use of torches or other flame-type devices will not be permitted. Sections of raceway showing evidence of scorching (brownish color) will be disapproved.
- B. Field bends for 2-inch diameter and larger raceway shall be made using internal support to prevent crimping or deforming during the bending process.

- 3.4 SUPPORT: Support raceways based on the temperatures at the application, but in no case shall the distance between supports be less than the requirements of NEC. Install raceway at least 6 inches away from steam lines and other heat sources.

END OF SECTION 16112

SECTION 16120

WIRE, CABLE, AND WIRING (SINGLE-CONDUCTOR)

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES: NEMA PUBLICATIONS

- A. WC 5 Thermoplastic-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. WC 7 Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.3 CONDUCTOR SIZES: Conductor sizes are based on copper.

1.4 WORK: Provide and install wiring required by applicable codes and necessary for a complete and functioning system

PART 2 - PRODUCTS

2.1 CONDUCTOR CODING

- A. Color code insulated grounding conductors in accordance with NEC 210-5(B).
- B. Color code current carrying conductors using the color coding convention existing in the facility:
 - 1. No. 12 thru No. 6 conductors shall have continuous insulation color.
 - 2. Color code conductors larger than No. 6 which do not have continuous insulation color by application of at least two laps of colored tape on each conductor at all points of access including junction boxes.
- C. Each coil of wire shall be delivered to the job in its original package bearing the UL label. Wire shall be marked with size and type every two feet. The neutral and each phase wire shall be furnished with different color insulation in sizes up to and including No. 6 AWG. Sizes No. 4 and larger may be provided in black, if identified by a series of two or more colored bands completely encircling the conductor, located at or near each terminal point, in all junction boxes and at all other points so designated by the inspecting authority. Colored bands shall not be less than 3 inch nor less than two conductor diameters in width, whichever is greater. The same color shall be used for each phase wire throughout the system for all three phase and feeder circuits as applicable for each voltage category.

2.2 CONDUCTOR REQUIREMENTS

- A. All conductors shall be copper.
- B. All wire and conduit sizes shown on the drawings are based on the use of copper conductors with Type THW insulation unless otherwise indicated.

2.3 POWER AND CONTROL CONDUCTORS

- A. Conductors shall be soft annealed copper.
- B. Provide No. 12 conductors, unless otherwise indicated.
- C. Conductors No. 8 AWG and larger shall be stranded.
- D. Conductors No. 10 AWG and smaller may be solid.
- E. Insulation
 - 1. Shall be type THW, THWN, XHHW.
 - 2. Shall be rated for 600 volts, 75 deg C unless otherwise indicated..

2.4 SPLICES

- A. Splices for conductors No. 10 and 12 AWG shall have the following features:
 - 1. Pre-insulated spring connector encased in a steel shell and rated at not less than 105 degrees C.
 - 2. Insulated vinyl cap with a minimum 3/8 inch skirt to cover the bare wires.
 - 3. UL approved for use in enclosures, junction boxes and fixtures.
 - 4. Manufacturer and type:
 - a. 3M Company, "Scotch Lok" Type Y, R and B
 - b. Ideal Industries, Wire Nut
 - c. Approved equal.
- B. No. 8 and larger wires:
 - 1. Compression connectors or splices as manufactured by Burndy, or T&B.
 - 2. Insulate to at least 200 pct. of wire insulation. Use pre-stretched tubing connector insulators, 3M Company, Type PST.

- 2.5 TERMINATIONS: All cable terminations shall be the compression barrel type with spades or studs for final connection to the equipment terminals.
- 2.6 PULLING COMPOUND: Pulling compound shall be Ideal Industries Yellow 77, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish and install all wire and cable of AWG sizes indicated on the drawings and as specified hereinafter or required for the complete installation.
- B. Install wiring in conduit.
1. Complete and clean out conduit system before pulling wire.
 2. Use compound as required to facilitate pulling.
 3. Pull conductors using recognized methods and equipment leaving ample lengths of wire at junctions for connections.
- C. Identify all wiring at all points of access including junction and pull boxes.

END OF SECTION 16120

SECTION 16133

PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 DESCRIPTION

- A. This section specifies boxes installed within buildings and outside above grade.

PART 2 - PRODUCTS

2.1 SHEET METAL BOXES SHALL HAVE THE FOLLOWING FEATURES:

- A. Acceptable Materials
 - 1. Type 5052 aluminum, minimum 0.080 inch thick, or
 - 2. Type 304 stainless steel, minimum 14 gage.
- B. Continuously welded seams.
- C. No knockouts.
- D. Rolled lip around door.
- E. Neoprene gasketed covers.
- F. Stainless steel hardware.
- G. Manufacturer and Type: Hoffman Bulletin A-4 or A-51.

2.2 CAST BOXES SHALL HAVE THE FOLLOWING FEATURES:

- A. Cast iron or copper-free aluminum construction.
- B. Finishes
 - 1. Cast iron: Hot-dip-galvanized or cadmium-zinc electroplated, aluminum cellulose lacquered.
 - 2. Copper-free aluminum: Gray epoxy powder
- C. Hardware: Stainless steel, brass, or bronze.

- D. Manufacturer: Appleton, Crouse-Hinds, or Killark.

2.3 CONDUIT BODIES

- A. Where of sufficient size, conduit bodies may be used in lieu of pull and junction boxes provided they meet the requirements of the NEMA standards referenced above.
- B. Material: Cast copper-free aluminum.
- C. Finish: Gray epoxy powder
- D. Hardware: Stainless steel.
- E. Manufacturer: Appleton, Crouse-Hinds, or Killark.

PART 3 - EXECUTION

- 3.1 Provide pull and junction boxes where shown on the drawings, and where required for changes in direction, at junction points, and to facilitate wire pulling. Provide additional boxes as required so that wire and cable manufacturer's maximum recommended pulling tensions are not exceeded.
- 3.2 Size boxes in accordance with NEC unless larger boxes are indicated.

END OF SECTION 16133

SECTION 16134

WIRING DEVICE BOXES

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

PART 2 - PRODUCTS

2.1 BOXES SHALL HAVE THE FOLLOWING FEATURES:

- A. Cast iron or copper-free aluminum construction.
- B. Finishes:
 - 1. Cast iron: Hot-dip galvanized or cadmium zinc electroplated, aluminum cellulose lacquered.
 - 2. Copper-free aluminum: Gray epoxy powder.

- 2.2 PLATES shall be copper-free aluminum with gray, powder epoxy finish, neoprene-gasketed, weatherproof, Crouse-Hinds WLRD for duplex receptacles, WLGf for ground fault receptacles and WLRS for single receptacles and light switches.

PART 3 - EXECUTION

- 3.1 Support all boxes to maintain alignment and rigidity.
- 3.2 Clean boxes of all foreign matter prior to installation of wiring or devices.

END OF SECTION 16134

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010, Electrical General Provisions, shall be made an integral part of this section.

1.2 REFERENCES

- A. National Electrical Manufacturers Association (NEMA) Publications.
 - 1. WD 1 General Purpose Wiring Devices.
 - 2. WD 3 Alternating-current General Use Snap Switches.
 - 3. WD 5 Specific-purpose Wiring Devices.
- B. Underwriters Laboratories (UL) Publications
 - 1. UL 20 General-use Snap Switches.
 - 2. UL 943 Ground-fault Circuit Interrupters.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish and install wiring devices at all locations shown on the drawings, complete with all mounting devices and other appurtenances where required. All wiring devices shall be the product of a single manufacturer except as specifically stated otherwise. The catalog numbers of the devices herein specified are based on those of Bryant Electric Co. However, equal devices as manufactured by General Electric, Leviton, or Hubbell will be acceptable. If other than Bryant devices are to be used, a list of comparative catalog numbers shall be furnished to the Architect.
- 2.2 AC GENERAL USE SNAP SWITCHES for control of lighting circuits shall be specification grade, full size, heavy duty, composition enclosed, AC type, rated for 20 amperes at 120-277 volts, Nos. 4901-G, 4902-G, 4903-G and 4904-G. Standard, competitive, residential grade and interchangeable line switches will not be acceptable.
- 2.3 RECEPTACLES SHALL HAVE THE FOLLOWING FEATURES:
- A. Ground fault interrupter type.
 - B. UL listed: UL 943 Class A

- C. Configuration: Duplex, NEMA 5-20R
- D. Trip current sensitivity: 5 milliamperes plus or minus 1 milliampere
- E. Trip speed: 0.025 second maximum for a fault of 264 milliamperes
- F. Electronic amplifier protection: 6000 volt transients, ringwave configuration
- G. Withstand rating: 2000 amperes
- H. Operating temperature range: minus 35 to plus 66 degrees C
- I. Front-accessible test and reset push buttons
- J. Color shall match non-ground fault, duplex, convenience receptacles.
- K. Manufacturer and type: Bryant GFR53FT series or equal by Hubbell, Leviton, or Pass & Seymour.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install A.C. general-use snap switches for switching lighting or other branch circuit loads as indicated on the drawings. Where adjacent to doors, coordinate with architectural drawings to ensure switches are installed on strike side of door.
 - 1. Locate centerline at the height of 48" above finished floor.
 - 2. Long dimension of switches shall be vertical unless otherwise indicated or required.
- B. Install receptacles as indicated on the drawings with grounding pole up.
 - 1. Locate centerline at the height of 18" above finished floor.
 - 2. Long dimension of receptacles shall be vertical unless otherwise indicated or required.
- C. It is intended that each such receptacle be equipped with ground fault interrupters. Do not use the feed thru feature to protect downstream receptacles.

END OF SECTION 16140

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.
- B. Supporting material shall be complete with hangers, connectors, bolts, clamps, and necessary accessories to make a complete installation.

1.2 LOADING

- A. Spans up to 5 Feet: Deflection shall not exceed $1 / 240$ of span.
- B. Spans 5 Feet and Greater: Deflection shall not exceed $1 / 360$ of span.
- C. Compressive loading shall not exceed 33 percent of manufacturer's published ratings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Supporting material shall be complete with hangers, connectors, bolts, clamps, and necessary accessories to make a complete installation.
- B. Indoors: Materials shall be galvanized or cadmium plated steel.
- C. Outdoors: Threaded materials shall be stainless steel or fiberglass-reinforced plastic. All other materials shall be aluminum, stainless steel, and / or fiberglass-reinforced plastic.
- D. Support systems shall be composed of standard structural shapes or factory fabricated. Acceptable manufacturers of factory fabricated support systems are:
 - 1. B-Line Systems, Inc.
 - 2. Midland-Ross Corporation, Electrical Products Division (Kindorf)
 - 3. T.J. Cope, Inc . (Aickinstruct)
 - 4. Unistrut

PART 3 - EXECUTION

3.1 SUPPORT

- A. General: Support all equipment which is not inherently self-supporting in such a manner as to effect a rigid and permanent installation.
 - 1. Use factory-fabricated channel, support systems, and as appropriate, other structural shapes such as angles, "C" channels, pipe, and the like.
 - 2. Do not support equipment from roof deck.
- B. Conduit support
 - 1. Runs along walls:
 - a. Single runs: Galvanized conduit straps or ring bolt type hangers with specialty spring clips.
 - b. Single runs: Use clamp and nest back spacers.
 - c. Multiple runs: Channel support with conduit fittings, 25 percent spare capacity.
 - 2. Suspended runs: Trapeze rack with 25 percent spare capacity.
 - 3. Vertical runs: Channel support with conduit fittings, 25 percent spare capacity.

3.2 ANCHOR METHODS

- A. Hollow masonry: Toggle bolts or spider type expansion anchors.
- B. Solid masonry: Lead expansion anchors or preset inserts.
- C. Metal surfaces: Machine screws, bolts, or welded studs.
- D. Concrete surfaces: Self-drilling anchors or powder- driven studs.

END OF SECTION 16190

SECTION 16420

ELECTRIC SERVICE

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES

- A. National Electrical Manufacturers Association (NEMA) Standards Publications
 - 1. ICS 6 Enclosures for Industrial Control and Systems

1.3 Electric service voltage and configuration shall be as shown on the drawings.

1.4 POWER COMPANY CONTACT INFORMATION:

- A. Name: American Electric Power
- B. Contact person: Ronnie S. Eubank, P.E.
- C. Phone number: 434-522-4281
- D. Email: rseubank@aep.com

1.5 SUBMITTALS

- A. Notify the Power Company of proposed work affecting electrical service requirements prior to beginning construction.

1.6 PROJECT CONDITIONS

- A. Charges by the Power Company for aid-to-construction costs for permanent electrical service will be paid by the Owner.
- B. Charges for temporary electrical service required during construction shall be paid by Contractor.

PART 2 - PRODUCTS

2.1 Metering cabinet shall have the following features:

- A. General: Cabinet construction shall meet the requirements for NEMA 3R enclosures prior to installation of any equipment or machining of opening for raceway.

B. Exterior Sheet Metal

1. 12-gage steel braced and supported to form a rigid structure suitable to support equipment to be mounted therein
2. No holes or knockouts prior to machining of openings
3. Door[s]
4. Three-point latching mechanism
5. Pad-lockable handle
6. Removable center post (two door enclosures only)

C. Interior Subpanels

1. 10-gage steel with rolled edges for rigidity
2. 2" thick A-D grade interior plywood

D. Finishes

1. One coat primer, two coats finish enamel
2. Interior color: Grey
3. Exterior color: Grey

E. Dimensions as required by Power Company

PART 3 - EXECUTION

3.1 Coordinate electric service with the Power Company.

3.2 Metering provisions shall meet requirements of Power Company.

- A. Install meter base(s) furnished by the Power Company.
- B. Install metering cabinet.
- C. Install conduit between the metering cabinet and the meter base(s) as required by Power Company.
- D. Mount Power Company metering transformers supplied by the Power Company.

END OF SECTION 16420

SECTION 16440

SAFETY SWITCHES

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES: NEMA PUBLICATION

- A. KS 1 Enclosed Switches

1.3 SCOPE

- A. Provisions of this section shall govern switches and fused switches provided as part of panelboards or other equipment.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

- A. Switches referred to as disconnect switches or motor circuit switches on the drawings shall be safety switches.
- B. Safety switches shall be the enclosed heavy duty type (Type HD) with quick-make, quick-break mechanism and external padlockable operating handle.
- C. Safety switches shall be rated for 240 or 600 volts as applicable. They shall be horsepower rated when used in motor circuits.
- D. Safety switches shall be:
 - 1. Fusible or non-fusible, as indicated on drawings.
 - 2. Single-phase circuits: two-pole
 - 3. Three-phase circuits: three pole
 - 4. Single throw unless otherwise indicated on the drawings.

2.2 ENCLOSURES

- A. Enclosures shall be NEMA 12 indoors and NEMA 4X outdoors unless otherwise indicated on drawings.

2.3 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer / Westinghouse
- B. General Electric
- C. Siemens
- D. Square D

PART 3 - EXECUTION

3.1 APPLICATION

- A. Provide safety switches where indicated on the drawings or required by NEC.

3.2 INSTALLATION

- A. Mount safety switches securely between 3 and 6 foot levels above floor unless otherwise indicated on the drawings.
- B. Furnish fuses for fusible switches of the size indicated on the drawings.

END OF SECTION 16440

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 SCOPE

- A. Grounding shall be in accordance with NEC as a minimum. Additional grounding requirements shall be as specified or indicated on drawings.

1.3 QUALITY CONTROL

- A. All system connectors shall be listed by Underwriters Laboratories for direct burial in earth or embedment in concrete per ANSI/UL467 Standard for Grounding and Bonding Equipment.
- B. All ground connectors shall meet the requirements of IEEE Std 837 Standard for Qualifying Permanent Connections Used in Substation Grounding.

PART 2 - PRODUCTS

- 2.1 GROUND RODS: Ground rods shall be copper clad steel, 10 feet in length and 3/4 inch in diameter.

2.2 CONDUCTORS

- A. Grounding electrode conductors shall be bare copper sized in accordance with NEC Table 250-66.
- B. Equipment grounding conductors in raceways shall be insulated copper sized in accordance with NEC 250-122.

2.3 CONNECTORS

- A. GENERAL
 - 1. All ground connectors shall be designed for fault-duty loading and shall have the fault capacity of the maximum sized conductor for which it is designed.
 - 2. Pad terminals and in-line splices shall accommodate only one conductor size. All other ground connectors may be range taking.

3. Structural steel and bus bar ground connectors shall accommodate only one rigid member conductor.
 4. All mechanical bonding connectors shall be designed to withstand 150% of the recommended installation torque.
- B. Exothermic type connectors shall be Cadweld, Thermoweld, or approved equal.
- C. Compression connectors shall have the following features:
1. Manufactured from pure, wrought copper in compliance with ASTM B30.
 2. Shall be provided with a corrosion-inhibiting compound pre-applied to the contact surfaces. The compound shall be compatible with the conductors accommodated by the contractor.
 3. Shall be provided with tin plating where required by the application.
 4. Shall be clearly and permanently marked with the following information:
 - a. Manufacturer's inspection symbol
 - b. Catalog number
 - c. Conductor accommodation(s)
 - d. Installation die index or die catalog number (compression)
 - e. Underwriter's Laboratories Listing Mark
 - f. The words "Suitable for Direct Burial", or "Direct Burial", or "Burial" as specified per ANSI/UL467
 5. Shall be Burndy HYGROUND or equal.
 6. Compression dies shall provide embossment of the connector upon successful installation. The embossed index shall match the marking on the installed connector.
 7. Connector marking information shall be legible after installation for inspector cross-reference.
 8. Closed barrel connectors shall have inspection holes at the appropriate location to verify proper cable insertion.
- D. Cable-to-pipe (water or process) connectors shall be as follows.
1. General: Bolts ("u" and straight), nuts, and lock washers shall be stainless steel.
 2. For connections to 2 to 1-1/2 inch (IPS) pipe: O-Z / Gedney Company Type ABG, Burndy Type GAR series, Thomas & Betts Cat No 2-TB or 3-TB, or approved equal.

3. For connections to 2 to 8 inch (IPS) pipe: O-Z / Gedney Company Type CB, Burndy Type GAR series, Thomas & Betts Cat No 3900 series, or approved equal.
4. For connections to pipes larger than 8 inch (IPS): O-Z / Gedney Company Type WG-2 with stainless steel strap and body, Burndy Type GAR series, Thomas & Betts Cat No 3900 series, or approved equal.

PART 3 - EXECUTION

3.1 Grounding electrode conductors and ground counterpoise

- A. Use #4/0 AWG bare copper for connecting ground rods.
- B. Install grounding electrode conductors and ground rod tops a minimum of 30 inches below finished grade.
- C. Connect grounding electrode conductors to pipes using cable-to-pipe connectors. Remove all finishes and oxidation from pipe sufficiently to allow 100 percent contact of connector with pipe.
- D. If earth resistance of the service grounding electrode is more than 25 ohms, notify Engineer.

3.2 Equipment grounding

- A. Install equipment grounding conductors in all raceways containing conductors having 100 volts or more to ground.
- B. Ground all enclosures.

3.3 CONNECTORS:

- A. Use compression or exothermic connectors for all connections that will be direct buried or inaccessible for inspection after construction is complete.
- B. Compression Connectors: Install compression connectors in accordance with the manufacturer's recommendations for conductor preparation (cleaning, pre-crimp), installation tool and die selection, and application of the proper number of crimps.

END OF SECTION 16450

SECTION 16461

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 DESCRIPTION

- A. Transformer ratings and special features shall be as indicated on drawings.

1.3 REFERENCES

- A. NEMA Publications
 - 1. ST 1 Specialty Transformers.
 - 2. ST 20 Dry-type Transformers for General Applications.
 - 3. TR 27 Commercial, Institutional, and Industrial Dry-type Transformers.
- B. UL Standard 506 Specialty Transformers.

PART 2 - PRODUCTS

- 2.1 Transformers shall be continuously rated isolating type for 60 hertz service unless otherwise indicated.
- 2.2 The structure shall be a rigid, self-supporting, completely metal-enclosed structure.
- 2.3 The enclosure shall completely enclose the equipment except for requisite ventilation openings. Such openings shall be covered with diamond-pattern expanded metal which will prevent the insertion 0.375-inch diameter rod into the interior of the enclosure.
- 2.4 The primary shall have two 2.5% full capacity taps above and four 2.5% full capacity taps below rated voltage.
- 2.5 Insulation systems shall be 220 degrees C (150 degrees C rise) for 37.5 KVA and above, single phase, or 30 KVA and above, three phase units.
- 2.6 Insulation systems shall be 185 degrees C (115 degrees C rise) for 0.25 KVA through 25 KVA, single phase, or 3 through 15 KVA, three phase units.

2.7. Audible sound levels shall not exceed the following:

15 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

2.8. Acceptable manufacturers for units 1 KVA and greater shall be as follows:

- A. Acme
- B. Cutler-Hammer / Westinghouse
- C. General Electric
- D. Hevi-Duty
- E. Siemens
- F. Square D

2.9 Enclosures for transformers shall be metallic, suitable for indoor or outdoor installation as applicable and rodent proof.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely mount transformers at location indicated on drawings.
- B. Install floor-mounted transformers on concrete housekeeping pads.
- C. Mount transformers so that vibrations are not transmitted to the structural parts of building.

3.2 CONNECTION: Make conduit connections with flexible conduit.

3.3 GROUNDING

- A. Ground the transformer case and the electrostatic shield via a full size, grounding electrode conductor.
- B. Bond the transformer neutral to the grounding electrode conductor.

END OF SECTION 16461

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Panelboards shall be of dead front construction utilizing thermal magnetic circuit breakers and shall conform to the requirements established by UL, NEMA and the NEC, except where modified herein. Each shall be suitable for its intended application as scheduled, considering voltage, phase, frequency and intended service. All panelboards shall be UL listed and shall be so labeled.
- B. Panels known as "loadcenters" will not be accepted.
- C. Panelboards shall consist of cabinet or back box, bus assembly, circuit breakers, trim, and all accessories as indicated and required. All characteristics shall be as shown or scheduled on the drawings.

2.2 CABINETS

- A. Cabinets or back boxes shall be fabricated from galvanized or equivalent rust resistant sheet steel of thickness to meet code requirements.
- B. Cabinet depths shall be the manufacturer's standard except where specific requirements indicate otherwise.
- C. Gutter(s)
 - 1. Gutter space shall meet UL and NEC requirements.
 - 2. Where a panelboard is arranged in a riser fed by cable and conduit, provide an auxiliary side gutter of sufficient cross sectional area to accommodate a feeder tap to the panelboard line lugs or the panelboard main breaker, as applicable.

2.3 BUS

- A. The bus assembly shall consist of copper or aluminum bus structure, secured and arranged to receive breakers as indicated.

- B. All bussing shall be designed in accordance with UL standards to suit the loading requirements as scheduled and shall be braced to withstand mechanical stresses created by faults of magnitude equivalent to the rating of breakers to be installed.
- C. Bus assembly shall include main lugs and main breakers where indicated. Arrangement shall also include double row construction of breakers and allowance for breaker replacement from the front without disturbing adjacent units or main bus connections. Bus and mounting pan shall be designed so that circuit breakers may be changed or added without additional machining, drilling or tapping.
- D. Connections to aluminum bus bars shall have special coating, such as plating or inhibiting compound, to prevent electrolysis. Belleville washers shall be used to prevent cold flow.
- E. Phase and neutral bus supports shall be insulated.
- F. Construction shall be such that the bus will not be exposed upon removal of trim.
- G. Provisions shall be included for adjustment of bus assembly and breakers for some vertical alignment and front-to-back position without removal of the assembly.
- H. All panelboards shall be provided with solid neutrals.
- I. Ground bus
 - 1. Grounding bars with lugs shall be provided on all panelboards.
 - 2. Ground busses shall be bonded to panel enclosure.
- J. Space where shown in panel schedules designates space for future protective devices and shall include bus and support components.

2.4 CIRCUIT BREAKERS

- A. Circuit breakers shall as specified in Section 16475 - Molded Case Circuit Breakers.

2.5 PANELBOARD FRONTS

- A. Panelboard fronts shall be of cold rolled steel in accordance with gauges required by code.
- B. Trim shall be fastened to box by means of clamps which indicate their position from the front. Trim clamps shall be concealed to present a flat smooth appearance. The use of screws engaging holes in the box flange for fastening trim will not be acceptable.
- C. Doors
 - 1. Doors shall be fastened to trim by flush concealed hinges.

- 2. Doors shall be equipped with a flush type combination catch and keyed lock. Two milled type keys shall be provided with each panel, and all locks shall be keyed alike.
- 3. Doors shall be equipped with a neat directory frame secured to the inside of the door.
- D. Trim and doors shall be properly cleaned and finished with one rust-inhibiting priming coat and a finish coat of light gray enamel, ANSI Z55.1-1967 No. 61. All circuits shall be identified as specified hereinafter.

2.6 MINIMUM SHORT CIRCUIT RATING

- A. The minimum short circuit rating for the panelboard shall be the rating of the device within the assembly having the lowest short circuit rating.
- B. Maximization of selective tripping coordination is the intent of this design. Use of series rated equipment will not be approved.

2.7 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer / Westinghouse
- B. General Electric
- C. Siemens
- D. Square D

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting: Bolt to wall such that top of enclosure is 72 inches above finished floor.
- B. Arrange and number circuits exactly as indicated in drawing schedules. If circuit arrangement does not match schedules, Contractor will be back-charged for the cost incurred by the Engineer in editing schedules for As-Built Drawings.
- C. Type entries on directory cards completely and accurately. Equip each circuit breaker with an identification label (as recommended by manufacturer) showing circuit number served. Numbers on identification labels shall match respective circuit numbers on directory cards.

END OF SECTION 16470

SECTION 16475

MOLDED CASE CIRCUIT BREAKERS (MCCB)

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES

- A. NEMA Publication AB 1 Molded Case Circuit Breakers.

1.3 SCOPE

- A. This section applies to all MCCB whether individually enclosed, group mounted or part of other equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Ratings and special features shall be as scheduled.
- B. Trips shall be thermal magnetic with inverse time delay and instantaneous time-current characteristics.
- C. 225 Ampere frame and larger MCCB shall have interchangeable trips and adjustable magnetic feature.
- D. MCCB shall be industrial grade; except, MCCB may be bolt-on, Quick-Lag "Q-Line" on 120 / 208 and 120 / 240 volt systems.

2.2 MINIMUM SHORT CIRCUIT RATING

- A. The minimum short circuit rating for an MCCB shall be its rating standing alone.
- B. Maximization of selective tripping coordination is the intent of this design. Use of series rated equipment will not be approved.

2.3 ENCLOSURES: Enclosures for individually enclosed MCCB shall be NEMA 12, unless indicated otherwise on drawings.

2.4 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer / Westinghouse

B. General Electric

C. Siemens

D. Square D

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install MCCB's as scheduled on the drawings.

B. Individually enclosed MCCB's: Mount enclosure such that its top is 6 feet above the floor.

END OF SECTION 16475

SECTION 16480

MOTOR STARTERS

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 SCOPE

- A. This section specifies starters shown on the drawings individually mounted; i.e., not an integral part of a piece of mechanical equipment.

1.3 REFERENCES: NEMA PUBLICATIONS

- A. ICS 1 General Standards for Industrial Control and Systems.
- B. ICS 2 Standards for Industrial Control Devices, Controllers, and Assemblies.
- C. ICS 6 Enclosures for Industrial Controls and Systems.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Starters shall be NEMA-rated. IEC-rated equipment will not be accepted.
- B. Starters and associated devices shall have NEMA 4X enclosures.
- C. Starters shall disconnect all un-grounded circuit conductors.
- D. Starters shall have 75°C - rated line and load lugs.

2.2 MANUAL STARTERS

- A. Overload:
 - 1. Thermal overload protection shall be trip-free and the hand reset type. Overload relays shall be Class 10.
 - 2. Each ungrounded phase or motor lead shall have overload protection in its starter.
 - 3. Overload relays in outdoor starters shall be ambient compensated.
 - 4. Elements sized upon nameplate running amperes of the actual motor installed.

- B. Shall have "quick-make" and "quick-break" mechanisms and be trip-free. They shall have provision for padlocking in the "on" and "off" positions.

2.3 MAGNETIC STARTERS

A. General

- 1. Starters shall be electro-mechanical.
- 2. Overload:
 - a. Thermal overload protection shall be trip-free and the hand reset type. Overload relays shall be Class 10.
 - b. Each ungrounded phase or motor lead shall have overload protection in its starter.
 - c. Manual reset in cover
 - d. Elements sized upon nameplate running amperes of the actual motor installed.
- 3. Auxiliary contacts: Two sets, form "C" in addition to those shown on the control wiring diagrams.

PART 3 - EXECUTION

3.1 GENERAL

- A. When motors are supplied with characteristics different from those indicated on the drawings, starters, feeders, overloads, disconnects, and associated devices of the correct size, type, and rating shall be provided.
- B. Provide full-voltage starters unless otherwise indicated.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Bolt to wall so that top of enclosure is 60 inches above finished floor.

END OF SECTION 16480

SECTION 16617

SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 SUMMARY

- A. These specifications describe the electrical and mechanical requirements for high energy transient voltage surge suppressors (abbreviated as "TVSS" in this specification and referred to on drawings as "surge suppressor").
- B. The specified system shall provide effective high energy surge current diversion, sine wave tracking for electrical line noise filtering and be suitable for application in ANSI / IEEE C62.41 Category B, and C environments, as tested by ANSI / IEEE C62.11, C62.45 and MIL-STD-220A.
- C. The system shall be connected in parallel with the protected system; no series connected elements shall be used which limit load current or kVA capability.

1.3 REFERENCES:

- A. The specified system shall be designed, manufactured, tested and installed in compliance with:
 - 1. American National Standards Institute and
 - 2. Institute of Electrical and Electronic Engineers (ANSI / IEEE C62.11, C62.41, and C62.45)
 - 3. National Electrical Manufacturer Association (NEMA)
 - a. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
 - 4. National Fire Protection Association (NFPA)
 - 5. Underwriters Laboratories (UL)
 - 6. UL 1449 - Standard for Transient Voltage Surge Suppressors (TVSS) (Second Edition)
 - 7. UL 1283 - Standard for EMI / RFI Facility Filters

1.4 LISTINGS

- A. The individual TVSS units shall be UL listed under UL 1449 Standard for Transient Voltage Surge Suppressions (TVSS) and the surge ratings shall be permanently affixed to the TVSS. The unit shall also be complimentary listed to UL 1283 Standard for EMI / RFI Facility Filters.

1.5 SUBMITTALS

- A. Equipment manual with installation, start-up, trouble shooting guide and operating instructions for the specified system.
- B. Electrical and mechanical drawings showing unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagram.
- C. Documentation of specified system's UL 1449 listing and clamping voltage ratings of all protection modes.
- D. Documentation of the specified system's UL 1283 complimentary listing shall be included as required product data submittal information.
- E. Independent fuse coordination tests from a nationally recognized independent testing laboratory.

1.6 WARRANTY

- A. The manufacturer shall provide a full ten-year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes.
- B. Manufacturer shall make available (local, national) field engineering service support. Where direct factory employed service engineers are not locally available, travel time from the factory or nearest dispatch center shall be stated.

1.7 QUALITY ASSURANCE

- A. The specified system shall be thoroughly factory tested before shipment.
- B. Testing of each system shall include, but shall not be limited to, quality control checks, dielectric voltage withstand tests at twice rated voltage plus 1000 volts per UL requirements, and operational and calibration tests.

PART 2 - PRODUCTS

2.1 TVSS's shall have the features listed below.

2.2 ENVIRONMENTAL

- A. Storage Temperature: Range shall be -40 to +65 C (-40 to +149 F)

- B. Operating Temperature: Range shall be -40 to +50 C (-40 to +122 F)
 - C. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.
 - D. Operating Altitude: The system shall be capable of operating up to an altitude of 14,000 feet above sea level.
- 2.3 Audible Noise: The TVSS shall not generate any appreciable audible noise.
- 2.4 Magnetic Fields: The unit shall not generate any appreciable magnetic fields and shall be suitable for use directly inside computer rooms.
- 2.5 Maximum Continuous Operating Voltage (MCOV): Greater than 115% of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS overvoltage (swell) conditions.
- 2.6 Operating Frequency Range: 47 to 63 hertz.
- 2.7 Overcurrent Protection (Fusing): All protection modes (including Neutral to Ground) of the TVSS shall be internally fused at the component level with the fuses I²T capability to allow the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. If the rated I²T characteristic of the fusing is exceeded, the fusing shall be capable of opening in less than one millisecond and clear both high and low impedance fault conditions. The fusing shall be capable of interrupting up to 300 KA symmetrical fault current with 600 VAC applied. This overcurrent protection circuit shall be monitored and provide indication of suppression failure / operability. Conductor level fuses or circuit breakers internal or external to the TVSS shall not be acceptable.
- 2.8 PROTECTION MODES
- A. Delta Systems: Line-Line and Line-Ground
 - B. Wye Systems: Line-Line, Line-Neutral, Line-Ground
- 2.9 PERFORMANCE RATINGS
- A. Shall be rated to divert the following current levels in each of the listed pathways of protection:
 - 1. 400,000 amperes per phase
 - 2. 200,000 amperes per mode
 - B. Clamping voltages shall be 800 vcc.
- 2.10 Surge Suppression Components: The TVSS / Filter shall be constructed using multiple surge current diversion arrays of metal oxide varistors (MOV), matched to 1% variance, each array rated for at least 40 KA and 10 surges at 25 kA or surge current capacity based on the standard 8 x 20 microsecond waveform. Each array shall be capable of withstanding over 1,250 pulses of

the 10KA IEEE 62.41 Category C surge current without failure when tested per C62.11, C62.45, suggested wait times. The array shall consist of multiple, gap-less, metal oxide varistors, with each MOV individually fused. The arrays shall be designed and constructed in a manner which ensures MOV surge current sharing. No gas tubes, silicon avalanche diodes or selenium plates / rectifiers shall be used. The status of each array shall be continuously monitored and a green LED shall be illuminated if the array is in full working order. All protection modes, including N-G, shall be monitored and internally fused, for compliance to NEC article 110.9, 110.10 and 280.22.

- 2.11 Connections: The unit shall be designed to be installed using the flexible conduit provided by TVSS manufacturer. All parallel connections to the TVSS shall be kept as short as possible.

2.12 ENCLOSURE

- A. The unit case shall be a plastic enclosure rated UL94-5V, the best rating for resistance to flammability available. Further, the enclosure shall be designed and tested to NEMA 12, 4 and 4X standards.
- B. The enclosure shall be arranged such that no pilot devices protrude beyond the face of the enclosure. If the standard product has such devices protruding beyond the face of the enclosure, install the unit in a larger, clear plastic enclosure.

2.13 STATUS MONITOR

- A. The unit shall have an internal status circuit that monitors the operational status of all modes of protection, including Line to Neutral, Line to Ground and Neutral to Ground. No manual testing shall be required to confirm the integrity of the suppression and filter systems. If the unit does fail, the green LED shall be extinguished and the red LED shall be illuminated.
- B. The unit shall be equipped with a summary alarm relay with one set of Normally Open and Normally Closed (Form C) dry contacts rated for 125 VAC, 1 Amp (minimum). The contacts shall change state and indicate a failure of the unit, a phase loss condition or a full power loss condition.
- C. The unit shall be equipped with a surge counter.

2.14 MANUFACTURER AND TYPE

- A. Citel
- B. EFI / PSP Products
- C. Liebert
- D. Square D
- E. Surge Suppression, Inc
- F. United Power

PART 3 - EXECUTION

- 3.1 Connect the TVSS in parallel to the power source, keeping conductors as short and straight as practically possible.
- 3.2 Twist the TVSS input conductors together to reduce input conductor impedance.

END OF SECTION 16617

SECTION 16620

EMERGENCY STANDBY POWER SYSTEM

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 DESCRIPTION

- A. A complete emergency standby power system shall be provided including a diesel engine generator set and all auxiliary systems required for automatic operation.

1.3 QUALITY ASSURANCE

- A. Renewal parts and major maintenance shall be readily available through authorized manufacturers' dealers located within 250 miles of this installation.
- B. A single manufacturer's dealer shall supply and warrant all equipment for the emergency standby power system. Warranty period shall be at least 2 years or 1,500 hours of operation, whichever occurs first.
- C. The engine, generator and all major items of auxiliary equipment shall be products of United States of America manufacturers regularly engaged in the production of such equipment, and shall be assembled, tested and shipped to the job site by the engine manufacturer or his authorized distributor maintaining a parts and service facility in the area.
- D. Acceptable manufacturers include:
 - 1. Caterpillar
 - 2. Cummins.
 - 3. Detroit Diesel
 - 4. Generac
 - 5. Onan

1.4 REFERENCES

- A. NEMA Publications:
 - 1. MG 1 Motors and Generators.

2. MG 2 Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators.
- B. NFPA 30 - Flammable and Combustible Liquids
- C. NFPA 37 - Stationary Combustion Engines and Gas Turbines.
- D. NFPA 110 - Standard for Emergency and Standby Power Systems.
- E. UL-142 - Steel Above Ground Tanks for Flammable and Combustible Liquids

1.5 SUBMITTALS

- A. Submit shop drawings including the following:
 1. Full technical data.
 2. List of installations of comparable size in local area, service and parts facilities complete with manufacturer's published data.
 3. Engine data including:
 - a. Number of cylinders
 - b. Piston displacement
 - c. Break mean effective pressure
 - d. Piston speed
 4. Manufacturer's installation instructions.
 5. Manufacturer's descriptive literature
 6. Blank startup and field test report.
 7. Catalog information for the power-line disturbance analyzer that will be used to monitor the acceptance tests.
 8. Wiring diagram showing interconnection of the following:
 - a. Generator
 - b. Generator remote monitoring panel
 - c. Main fuel tank
 - d. Battery charger

9. Structural drawings of the generator concrete pad (inertia block): Drawings shall be prepared by a professional engineer licensed in the state in which the project is located.
- B. Submit operating instructions, and maintenance and repair data. Furnish manuals in duplicate. Framed operating instructions shall be mounted on or near the unit.
- C. Instruct Owner personnel in performance of routine maintenance and operation.

PART 2 - PRODUCTS

2.1 GENERATOR

- A. Generator voltage and phase ratings shall be as indicated on the drawings.
- B. Frequency shall be 60 Hz
- C. Minimum standby KW ratings shown on the drawings are estimated. Depending upon the engine/generator combination provided, these ratings shall be increased if necessary to carry the indicated loads. Any other changes necessitated by a change in generator capacity shall also be made at no additional cost to the Owner.
- D. Voltage regulation
 1. Motor starting subtransient voltage dip shall not exceed 20 percent. Voltage regulation shall be no more than 4 percent from no load to full load.
 2. Readily accessible voltage drop, voltage level, and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of plus or minus 5 percent.
- E. Generator insulation shall be Class B, F, or H. Temperature rise shall not exceed 105 degrees C over 40 degrees C ambient for continuous operation at the standby rating.
- F. Frequency regulation from no load to full load shall be in accordance with governor specification. For any addition of load up to 90 percent of rated load the frequency shall recover to steady state frequency band within 5 seconds.

2.2 ENGINE

- A. Engine shall be four cycle diesel
- B. Engine shall have not less than four cylinders.
- C. All engine ratings shall be shown in manufacturer's literature published at least 6 months prior to bid opening, and engine shall be of a design that has been successfully used for at least 3 years.
- D. Generator shall be driven by a single engine without the use of gearing.

- E. Minimum engine compression ratio shall be 16 to 1.
- F. Cylinder liners shall be removable, close grained alloy iron. Main, connecting rod, and cam shaft bearings shall be replaceable.
- G. The crankshaft shall be steel forged, dynamically and statically balanced with hardened journals.
- H. The cylinder block shall be a one-piece ferrous casting containing full length water jackets.
- I. Valve guides and seat inserts shall be replaceable.
- J. Instrument panel shall be engine mounted and contain fuel pressure gage, water temperature gage, and lubricating oil pressure gage.
- K. Engine lubrication shall include a forced feed lubricating oil system with wet sump.
 - 1. Lube oil cooler shall be water cooled.
 - 2. Oil filters shall be replaceable with spring loaded bypass valve to insure oil flow if filter clogs.
- L. Engine combustion air cleaner shall be heavy duty industrial oil bath type air intake cleaner mounted on engine or dry replaceable element type cleaner.
- M. Engine fuel system (diesel fuel):
 - 1. Shall be fuel injection type capable of performance on commercial grade No. 2 fuel oil.
 - 2. Provide primary and secondary fuel filters of replaceable cartridge type.
 - 3. Fuel pump shall be positive displacement, engine mounted type capable of 12 foot minimum suction shall be provided.
 - 4. All fuel lines shall have flexible connections and a check valve shall be provided ahead of the fuel pump.
 - 5. The fuel storage tank shall be a skid-mounted, belly tank sized for a minimum of forty-eight hours operation. Tank shall be double-walled and have a low fuel switch, high fuel switch and a leak detection switch. If leak detection switch requires power, it shall be suitable for operation off of the battery charger alternating current power source.
- N. Engine exhaust system:
 - 1. Shall include a minimum 12 inch long flexible steel exhaust connection for each exhaust outlet to muffler.

2. Muffler shall reduce noise to not more than 85 decibels at 25 feet from the end of the exhaust pipe.
 3. Insulation:
 - a. The muffler and complete exhaust pipe (except flexible portion) shall be insulated to the exhaust manifold.
 - b. Muffler insulation shall prevent temperature of accessible surfaces from exceeding 150 degrees F.
 4. Muffler shall be equipped with a threaded drain hole.
- O. Engine exhaust emissions shall not exceed the limitations of applicable regulations.
- P. Engine governor shall be fully electronic, isochronous type to maintain governed speed at precise isochronous control for 60 hertz operation. The frequency at any constant load shall remain within a steady state band width of plus or minus 0.25 percent of rated frequency.
- Q. Jacket water heater shall be thermostatically controlled, sized to maintain jacket water temperature at 40 degrees F with ambient of -20 degrees F. Heater voltage shall be suitable for circuit voltage shown on drawings.
- R. Radiator shall be engine mounted and cooled by blower fan. Fan belts if used shall be "v" type and have tension adjustment. The radiator shall be capable of cooling the engine at its standby load ratings and 110 degrees F ambient air temperature. The radiator shall be filled with ethylene glycol and water solution to protect to minus 20 degrees F and shall include a cooling system rust inhibitor. All cooling system gaskets shall be suitable for use with ethylene glycol.
- S. Water circulating pump shall be engine driven. Thermostatic water valve shall maintain engine at recommended temperature level.
- T. Generator controls shall be mounted on the generator.
1. The controls shall include the following meters:
 - a. AC voltmeter
 - b. AC ammeter
 - c. Frequency meter
 - d. Running time meter
 - e. Oil pressure gage
 - f. Water temperature gage

2. The controls shall include the following alarms which shall light an individual indicating lamp for each, stop, and lock out the unit. Lockout shall require manual reset.
 - a. Overcrank
 - b. Low oil pressure
 - c. High water temperature
 - d. Overspeed
 - e. Low fuel
3. The controls shall accommodate remote engine control signals from the transfer switch.

2.3 ACCESSORIES

- A. Engine-generator set shall be provided with spring type vibration isolators secured to a common steel channel or H-beam type engine generator base and bolted to the foundation. Vibration isolators shall be sized per the VUSBC for the seismic zone in which the project is located.
- B. Circuit breaker shall be 100%-rated, molded case, solid state trip type having long time, short time, instantaneous and ground fault trips.
- C. Generator remote monitoring panel:
 1. Shall include visual indication of the following:
 - a. Overcrank Alarm.
 - b. Low Water Temperature Alarm.
 - c. High Engine Temperature Alarm.
 - d. Low Lube Oil Pressure Alarm.
 - e. Overspeed Alarm.
 - f. Fuel Tank Rupture Alarm.
 - g. Generator control Switch Not in AUTO Position Alarm.
 - h. Battery charger malfunctioning
 - i. Low Battery Voltage Alarm.
 - j. High Battery Voltage Alarm.

- k. Lamp Test Switch
- l. Alarm retransmission contact (open when no alarm conditions are present) which shall change status upon occurrence of any of the alarms listed above.
- 2. Shall be suitable for operation on 120 vac power source.
- 3. Shall have battery backup for 30 minutes.
- E. Engine starting system shall have the following features:
 - 1. Batteries
 - a. Lead acid type.
 - b. Sufficient capacity to provide three successful starting attempts of 30 seconds each at a cranking speed sufficient to start the engine at a temperature of 0 degrees F. Two minute rest periods will be allowed between successive attempts.
 - c. Single cell type, cells connected using bolted bus links.
 - d. Floor-rack-mounted rack shall be resistant to the corrosive effects of the battery electrolyte.
 - 2. Charger
 - a. Operation: Recharges the battery after engine cranking or interruption of AC power by automatically switching from the normal float voltage to the equalize voltage. Upon reaching the equalize potential, the charger reverts to its nominal float potential until the next power interruption or cranking cycle.
 - b. Ambient temperature compensation and voltage regulation (plus or minus 1.5 percent, equalize and float) to prevent overcharging and associated water loss at high temperatures, and to assure that battery is fully charged at low temperatures.
 - c. Output current limiting: 115 percent of rated.
 - d. Output voltage limiting.
 - e. AC and DC fuses.
 - f. Voltmeter (3.5 inch movement, plus or minus 2 percent accuracy).
 - g. Ammeter (3.5 inch movement, plus or minus 2 percent accuracy).
 - h. Float voltage adjustment (factory-set).

- i. Equalize voltage adjustment (factory-set).
 - j. Battery charger failure alarm contacts, form C contacts rated 1 amp, 120 volts minimum:
 - (1) High battery voltage
 - (2) Low battery voltage
 - (3) Charger failure
 - k. AC input transient overvoltage protection.
 - l. DC output transient overvoltage protection.
 - m. DC output reverse polarity protection.
 - n. Ambient temperature range: 0 to 50 degrees C.
 - o. Float charge indicator.
 - p. Equalize charge indicator.
 - q. NEMA 1 enclosure.
3. DC Cables:
- a. Insulation shall withstand exposure to battery electrolyte.
 - b. Stranded, extra flexible type (building wire not acceptable).
- E. Finish paint coat of engine generator set, accessories, and auxiliary equipment shall be standard factory color.
- 2.4 Generator shall be in an enclosure having the following features:
- A. Weatherproof, rodent-proof
 - B. Constructed of steel, 12 gage minimum with baked enamel finish of standard factory color.
 - C. Hinged lockable doors to provide access to all areas requiring access for operation or routine maintenance.
 - D. Removable panels for areas requiring access for non-routine maintenance.
 - E. Peaked or sloped roof.
 - F. Expanded metal radiator grill.

- G. Fixed air intake louvers.
- H. Sufficient space to house the batteries, charger and muffler.

PART 3 - EXECUTION

- 3.1 Provide emergency standby power system where indicated on drawings.
- 3.2 Provide a nameplate at the service entrance equipment indicating type and location of emergency power source.
- 3.3 Install generator on a steel-reinforced concrete pad (inertia block) having chamfered edges designed as recommended by the generator manufacturer and per the VUSBC for the seismic zone in which the project is located.
- 3.4 Generator remote monitoring panel:
 - A. Install in location indicated on drawings.
 - B. Provide wire and conduit necessary to interface remote monitoring panel to generator on-board controls.
- 3.5 COMMISSIONING shall be in accordance with Section 16040 – Testing and Placing in Service.
- 3.6 Fill fuel system to capacity after completion of commissioning.

END OF SECTION 16620

SECTION 16625

EMERGENCY STANDBY POWER AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. Provisions of Section 16010 - Electrical General Provisions shall be made an integral part of this section.

1.2 REFERENCES

- A. NEMA Publications
 - 1. ICS 1 General Standards for Industrial Control and Systems.
 - 2. ICS 2 Standards for Industrial Control Devices, Controllers, and Assemblies.
 - 3. ICS 6 Enclosures for Industrial Controls and Systems.
 - 4. ICS10 - AC Automatic Transfer Switches
- B. NFPA 110 - Standard for Emergency and Standby Power Systems.
- C. UL 1008 - Standard for Automatic Transfer Switches
- D. NFPA 70 - National Electric Code
- E. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- F. NEC Articles 700, 701, 702
- G. International Standards Organization ISO 9001

1.3 QUALITY ASSURANCE

- A. Transfer switches shall be tested and constructed in accordance with ANSI / UL 1008, Safety Standard for Automatic Transfer Switches, NEC 700 (701) and 702. Transfer switches shall meet impulse withstand voltage test requirements as designated in ANSI / NEMA ICS 1, General Standards for Industrial Control and Systems, and they shall meet voltage surge withstand capability as designated in ANSI / IEEE C37.90, IEEE Standard Relays and Relay Systems Associated with Electric Power Apparatus.

1.4 SUBMITTALS

- A. Certified test data prepared by a nationally recognized testing laboratory to confirm the following switching abilities:

1. Overload and endurance at rated voltage in accordance with tables 21.1 and 23.2 of UL 1008 when the switches are mounted in unventilated enclosures.
2. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within allowable temperature limits of insulation in contact with current carrying parts.
3. Symmetrical withstand current values as covered in the individual switch specifications as shown on the drawings.
4. Dielectric test at 1000 volts plus twice rated voltage after withstand current test.
5. Capability of the transfer switches to operate by normal operating means after the withstand current test.
6. Dimensioned exterior outline drawings showing conduit access and door swings.
7. Dimensioned interior drawings showing and identifying all devices.
8. Wiring diagrams

B. Blank startup and field test report.

- 1.5 SCOPE: Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

PART 2 - PRODUCTS

2.1 TRANSFER SWITCH

A. SWITCH

1. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
2. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
3. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.

4. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
5. Design utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

B. MICROPROCESSOR CONTROLLER WITH MEMBRANE INTERFACE PANEL

1. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
2. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.
3. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - a. ANSI C37.90A/IEEE 472 Voltage Surge Test
 - b. NEMA ICS - 109.21 Impulse Withstand Test
 - c. IEC801-2 - Electrostatic Discharge (ESD) immunity
 - d. ENV50140 and IEC 801 - 3 Radiated electromagnetic field immunity
 - e. IEC 801 - 4 Electrical fast transient (EFT) immunity
 - f. ENV50142: Surge transient immunity
 - g. ENV50141: Conducted radio-frequency field immunity
 - h. EN55011: Group 1, Class A conducted and radiated emissions
 - i. EN61000 - 4 - 11 Voltage dips and interruptions immunity
4. Controller shall be flush-mounted display with LED indicators for switch position and source availability. It shall also include test and time delay bypass switches.

C. VOLTAGE AND FREQUENCY SENSING

1. The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.
2. Single-phase voltage and frequency sensing of the emergency source shall be provided.

D. TIME DELAYS

1. An adjustable time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
2. An adjustable time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.
3. An adjustable time delay shall be provided on retransfer to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
4. A 15-minute cool down time delay shall be provided on shutdown of engine generator.
5. All adjustable time delays shall be field adjustable without the use of tools.

E. ACCESSORIES

1. A set of gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
2. A push-button type test switch shall be provided to simulate a normal source failure.
3. A push-button type switch to bypass the time delay on transfer to emergency, the engine exerciser period on the retransfer to normal time delay, whichever delay is active at the time the push-button is activated.
4. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided as follows:
 - a. One contact, closed when the ATS is connected to the normal source
 - b. One contact, closed, when the ATS is connected to the emergency source.
 - c. One contact closed when mode control switch is not in AUTO position.

- d. One contact, closed when under voltage or phase voltage imbalance is detected.
6. Indicating lights shall be provided, one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red). Also provide indicating lights for both normal and emergency source availability.
7. Programmable Engine Exerciser: A seven day electronic time switch for automatic weekly testing of the engine - generator set. The exercises shall be fully programmable and backed up by a permanent battery.

F. WITHSTAND AND CLOSING RATINGS

1. The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans. WCR ATS ratings to be as follows with specific circuit breakers:

ATS Size	Withstand & Closing Rating MCCB	W/CLF
30-200	22,000A	200,000
225-400	42,000A	200,000
600-1200	65,000A	200,000
1600-2000	85,000A	200,000
2600-3000	100,000A	200,000

2.2 TESTS AND CERTIFICATION

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification, including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third part certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

2.3 SERVICE REPRESENTATION

- A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service

center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

- B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.
- C. For ease of maintenance and parts replacement, the switch nameplates shall include drawing numbers, part numbers for main coil, and control.

2.4 ENCLOSURE shall be NEMA 1.

2.5 ACCEPTABLE MANUFACTURERS

- A. Automatic Switch Company
- B. Russelectric, Inc.
- C. Zenith Controls, Inc.
- D. Cummins

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting:
 - 1. Enclosures 66 inches high and less: Bolt to wall such that top of enclosure is 72 inches above finished floor.
 - 2. Enclosures greater than 66 inches high: Install on 4-inch high concrete housekeeping pad having chamfered edges. Bolt to wall for stability.
- B. Provide conduit, wiring, and connections required and recommended by unit supplier.

3.2 STARTUP AND TESTING

- A. On completion of the installation, the initial start-up and testing shall be performed by a factory trained representative of the transfer switch manufacturer.
- B. At the time of start-up, operating instructions and maintenance procedures shall be thoroughly explained to the Owner's operating personnel.
- C. Perform operational tests on the complete system in the presence of the Engineer.
- D. In addition to manufacturer's standard field testing, megger switches in both positions prior to energizing either source.

END OF SECTION 16625